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## FATHER MERSENNE'S WAR AGAINST PYRRHONISM

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One of the most important and most neglected figures in the history of modern philosophy is Father Marin Mersenne.<sup>1</sup> He has been categorized, though unfairly, as a bigoted religious figure who is remembered primarily because of his life-long friendship with René Descartes. However, this picture hardly corresponds with the vital role Father Mersenne played in the scientific revolution of the seventeenth century.

Mersenne was a polemicist against a host of "monsters" that arose in the late Renaissance—atheists, deists, alchemists, naturalists, Cabalists, and Pyrrhonists. He was a man with a voracious interest in various scientific and pseudoscientific questions ranging from complex problems in physics and mathematics, Hebrew philology, theory of music, to such problems as the height of Jacob's ladder and the reason why wise men earn less money than fools. The service Mersenne rendered to the development of the "new science" was probably unequalled in his day. He published a vast number of summaries, explanations, and systems of scientific works, including those of Galileo. He aided and abetted Gassendi, Hobbes, Descartes, Herbert of Cherbury, and many others in their work. During his lifetime, Father Mersenne functioned as a one-man society for the advancement of science through his publications and immense correspondence in which he kept the leading European scientists informed of each other's work.

Mersenne was born in 1588 and was one of the first to be trained at the Jesuit college at La Flèche. He then entered the order of the

Minims, where he became a model of Christian piety and wisdom. In the third decade of the seventeenth century he began publishing vast polemical tracts against every conceivable enemy of religion and science. Following this, Mersenne devoted himself to the more constructive task of being a propagandist for the "new science." Until the time of his death in 1648, he exhibited his love of God through his Herculean labors in furthering the scientific revolution. The official biography of Mersenne, put out by his religious order, quoted one of the tributes paid to him, which said that only Mersenne and Gassendi, of all of the mathematicians of the day, rivalled Euclid and were legitimate successors of Ptolemy.<sup>2</sup>

The long neglect of Mersenne has recently been corrected by the excellent study by the Abbé Robert Lenoble, entitled *Mersenne ou la Naissance du Mécanisme* (Paris, 1943). In this work, Lenoble argues that Mersenne was not only one of the major figures in the philosophical and scientific revolution of the seventeenth century but was also the first to state the positivistic-pragmatic conception of scientific knowledge, by offering a nonmetaphysical interpretation of the "new science." The honor of being the first of the moderns, traditionally given to Francis Bacon or René Descartes, Lenoble declares, belongs more properly to Marin Mersenne. By means of a thorough examination of Mersenne's writings, Lenoble offers ample evidence to support this astounding thesis. His argument is quite convincing, though a somewhat similar claim could probably be made out for Mersenne's good friend and contemporary, Petrus Gassendi.

Mersenne's novel views concerning the philosophy of science are carefully developed in Lenoble's study, which describes how Mersenne rejected completely the notion of a rationalist physics and mathematics which grounded our knowledge of nature and numbers on some metaphysical foundation guaranteeing its truth. Instead he offered a new theory of science and mathematics, in which science consisted of a

<sup>1</sup>I should like to express my gratitude to M. l'Abbé Robert Lenoble for his helpful suggestions, criticisms, and encouragement. Also, I am indebted to Dr. Theodore Waldmann, who read the manuscript, for his critical comments.

<sup>2</sup>F. Hilarion De Coste, *La Vie du R. P. Marin Mersenne Theologien, Philosophe et*

*Mathematicien de l'Ordre des Peres Minimes* (Paris, 1649), p. 42.

<sup>3</sup>*L'Impieté des Deistes, Athees, et Libertins de ce temps, combatuë, & renversee de point en point par raisons tirees de la Philosophie, & de la Theologie* (Paris, 1624).

series of hypothetical judgments based on observations, connected in a systematic logical-deductive structure. This body of propositions could never be known with certainty to describe the "true nature of things." Science is the way in which we deal with the world of appearances. Men have to act regardless of what the real nature of things might be. Similarly mathematics is not knowledge of a transcendent reality but a system of deductive relationships about possibilities that might obtain. The theorems of geometry are true *if* there are such things as points, lines, and planes in the world.

It is not the purpose of this paper to examine this picture of Mersenne's philosophy of science but rather to consider one of Lenoble's sub-theses about it; namely, that Mersenne's novel interpretation of scientific knowledge constitutes a refutation of Pyrrhonian skepticism. In one of Mersenne's works entitled *La Verité des Sciences contre les Septiques* [sic] *ou Pyrrhoniens* (Paris, 1625), in which he discussed philosophy of science, he claimed to demolish skepticism by means of his analysis of science and mathematics. What I shall try to show, through examining Mersenne's war against Pyrrhonism, is that the attack presented and the philosophy of science advocated constitute in fact a type of skepticism which lies at the heart of what may be called "the scientific outlook," and that it is this new type of skepticism, a "constructive Pyrrhonism," that is one of Mersenne's most important contributions to modern thought.

The battle with the skeptics came at the end of Mersenne's polemical period (1623-25), during which he had written some enormous tomes like the *Quaestiones celeberrimae in Genesim* (Paris, 1623) and *L'Impiété des Déistes, Athées et Libertins de ce temps*<sup>3</sup> in order to destroy various types of infidels, heretics, and free-thinkers by means of argument and abuse. The work against the skeptics, *La Verité des Sciences*, completes this series of tracts against the enemies of reason and religion, and reflects some of the agitation of the time to stop the rising wave of Pyrrhonian thought.

Mersenne's polemic against the skeptics is one of the early attacks in the first half of the seventeenth century, which was followed by many, many others from thinkers who were impressed or depressed

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by the success of the revival of Greek skepticism.<sup>4</sup> Whereas most of the refutations were directed against the views of Montaigne and his disciple, Pierre Charron (with whom Mersenne had dealt in *L'Impiété des Déistes*), *La Verité des Sciences* considers the views of Sextus Empiricus, which appeared in Paris in 1621. They had just been published in Greek and Latin and were apparently creating quite a stir in the learned world. In examining the basic form of the skeptical arguments in their most didactic presentation, Mersenne tried to offer a different approach to these old problems. Instead of answering the skeptics in terms of the Aristotelian theory of knowledge, as was usually done, he attempted to show that a proper understanding of the sciences and mathematics, in terms of the "new philosophy," would vitiate the force of the Pyrrhonian doubts.

Mersenne's book begins with an extremely bombastic letter to the brother of the king. In this epistle, Mersenne announced that he was attacking the enemies of the truth of the sciences, the skeptics, the *libertins*, who are unworthy to be called human beings. Since they are unable to support the light of truth, they sacrifice themselves shamefully to errors and limit all human knowledge to the senses and to the external appearances of things. They reduce us, Mersenne con-

<sup>4</sup>See, for example, Jean Bagot, *Apologeticus fidei* (Paris, 1644); Pierre Chanet, *Considérations sur la sagesse de Charon* (Paris, 1643); François Garasse, *La Doctrine curieuse des Beaux esprits de ce temps, ou pretendus tels* (Paris, 1623), and *La Somme theologique des veritez capitales de la religion chrestienne* (Paris, 1625); Jean de Silhon, *Les deux Veritez, l'une de Dieu et sa Providence, l'autre de l'immortalité de l'Ame* (Paris, 1626), and *De l'Immortalité de l'Ame* (Paris, 1634); Charles Sorel, *La Science des Choses Corporelles* (Paris, 1634); Yves de Paris, *La Theologie naturelle* (Paris, 1633-36).

<sup>5</sup>"Ils s'appellent Septiques, & sont gens Libertins, & indignes du nom d'homme qu'ils portent, puisque comme oyseaux funestes de la nuit n'ayans pas la prunelle assez forte pour supporter l'éclat de la verité ils sacrifient honteusement au mensonge, & bornans toute la conoissance des hommes à la seule portée des sens, & à l'apparence extérieure des choses, nous

ravalent indignement à l'état le plus vil, & à la condition la plus basse des bestes les plus stupides & nous depouillent de l'usage de tout veritable discours, & araisonnement" (Mersenne, *La Verité des Sciences*, in dedication to Monsieur frère du Roy, p. 2).

<sup>6</sup>Lenoble suggested that Mersenne wrote the work between chats with Naudé and La Mothe Le Vayer. Lenoble, *Mersenne*, pp. 193-95.

<sup>7</sup>See, for example, the bombastic works of Father Garasse cited in n. 4, as well as Jean Boucher, *Les Triomphes de la Religion Chrestienne* (Paris, 1628); and Charles Cotin, *Discours a Theopompe sur les Forts Esprits du Temps* (1629).

<sup>8</sup>Mersenne, *La Verité des Sciences*, preface, p. ii.

<sup>9</sup>*Ibid.*, preface, p. iii.

<sup>10</sup>*Ibid.*, pp. 1-11.

<sup>11</sup>"Ce peu de science suffit pour nous servir de guide en nos actions" (*ibid.*, p. 14).

tended, to the most vile state, to the condition of the lowest and stupidest of beasts, depriving us of all discourse and reason.<sup>5</sup> This is rather forceful language, especially for a man whose good friends, Gabriel Naudé, François de La Mothe Le Vayer, and Petrus Gassendi were avowed skeptics.<sup>6</sup> But compared to some of the charges made at the time,<sup>7</sup> Mersenne's remarks are somewhat restrained. The preface, however, goes further, adding more charges, claiming that the skeptics are those *libertins* who are afraid to show their impiety and hence go about in a devious fashion attacking the sciences, religion, and morality by trying to convince us that nothing is certain.<sup>8</sup>

The purpose of his huge tome, Mersenne said, is to stop the impetuous course of Pyrrhonism. Any skeptic who reads it will see "that there are many things in the sciences which are true, and that it is necessary to give up Pyrrhonism if one does not want to lose his judgment and his reason."<sup>9</sup>

To achieve this aim, the book presents a dialogue between three philosophers—an alchemist, a skeptic, and a Christian philosopher. The alchemist starts the discussion by stating that alchemy is *the* perfect science. The skeptic rebuts, first by attacking alchemy and then by developing an assault on human knowledge in general through maintaining that no one knows what things really are in themselves. A summary of the classical Pyrrhonian case is offered, claiming that we see only appearances of things, not their real natures, essences, or Platonic Forms. We perceive only effects, whereas genuine knowledge depends upon causes. The number of causes of anything can be traced back *ad infinitum*. We cannot even know individual entities from which to abstract knowledge, since we do not know the causes that explain any individual thing. To know even a piece of paper, one would have to know the entire universe because all the relations in which the paper is involved are part of knowing the paper.<sup>10</sup>

At this point, the Christian philosopher makes his first reply, pointing out that all that the skeptic has shown so far is that we know few things rather than that we know nothing. And this limited knowledge, even if it is restricted to effects rather than causes, has a pragmatic value, for "this little knowledge suffices to serve as a guide in our actions."<sup>11</sup> All that we have to know to get along in this world are

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the effects, since by them we can distinguish various things from one another. Thus, these initial skeptical arguments are inconsequential.

Next, some of the classical sense-variation arguments of the Pyrrhonists are introduced. But the Christian philosopher shows that even if our sense experiences differ from those of other animals and other humans, we can at least discover certain laws about sense observations which constitute a science of sorts. This science will not deal with things-in-themselves but with laws about how objects appear under various conditions, like the laws of refraction. Such laws will allow us to correct our sense observations.<sup>12</sup> And the variations in moral and religious behavior prove nothing since both natural and divine rules of conduct are known to us.<sup>13</sup>

The skeptic's appeal to the diversity, relativity, and mutability of human views in the sciences and in religion<sup>14</sup> fails to raise serious doubts. Regardless of the variations in experience and opinions in every field of knowledge, some things are known to be true; for example, that the whole is greater than the part, that the light at noon is greater than that of the stars, and that it is not possible for the same thing to both have and not have the same property. In physics, nobody really denies that there are some things in the world—bodies, motions, light, and so on. We may all judge differently, but we all agree that there is something to judge. In ethics, there are undoubted principles like "evil should be avoided, good sought." The diversity of moral theories is due to mistakes or to difficulties about trivial problems, but not to doubts about these basic principles. A Pyrrhonian who doubts these obvious rules of morality is heading for disaster, into libertinism, which leads headlong to eternal damnation. If one becomes reasonable about these matters, one will know something, be happy, and even eliminate religious disputes. Here the Christian presents a summary of the evidence for his religion (to which the

<sup>12</sup>*Ibid.*, pp. 16-20. In this section Mersenne also pointed out that the skeptical tropes dealing with animal perception are irrelevant, since we have no way of telling what animals perceive.

<sup>13</sup>*Ibid.*, p. 21.

<sup>14</sup>*Ibid.*, pp. 22-40.

<sup>15</sup>*Ibid.*, pp. 41-74.

<sup>16</sup>*Ibid.*, pp. 75-129.

<sup>17</sup>"Cela n'est . . . pas nécessaire pour établir quelque vérité" (*ibid.*, pp. 150-51).

<sup>18</sup>*Ibid.*, pp. 133-56.

<sup>19</sup>"Tous les discours des Pyrrhoniens ne sont autre chose que chicaneries, & paralogismes, ausquels il ne faut pas s'amuser plus long temps" (*ibid.*, p. 153).

<sup>20</sup>*Ibid.*, pp. 156-62.

skeptic replies that he too is a good Catholic, but he is also still a Pyrrhonist.)<sup>15</sup>

After a temporary change of topic to attack alchemy,<sup>16</sup> Mersenne then developed his answer to skepticism in detail as a commentary and refutation of almost all of Book I and a part of Book II of Sextus Empiricus's *Outlines of Pyrrhonism*. First the material of Sextus (Book I, chaps. 1-13) is briefly summarized. Then the ten tropes are each presented and refuted in terms of a more extended version of what has already been said; that is, that there are scientific laws about sense variations, such as the principles of optics, and that in spite of all disagreement and divergence of opinions, there is common agreement on some matters. No one really doubts that fire is hot or ice is cold or that an elephant is bigger than an ant. Even the problems raised by the skeptics about dreams and frenzies, which Descartes was to make so much of, are dismissed by merely pointing out that when we are awake and in sound mental condition, we recognize dreams and hallucinations for what they are.

The skeptics claim that the ten tropes show that we do not know the essences of things. The Christian philosopher shrugs this aside with a pragmatic reply, "That is not . . . necessary to establish some truth."<sup>17</sup> In spite of the cases offered by Sextus Empiricus, we do not happen to be in doubt about everything because we have means of dealing with the problems, like measuring devices, and we have truths that we do not in fact doubt. We discover laws of perspective, of refractions, of the effect of wine on eyesight, and so on, and hence do not become disturbed about such things as bent oars and round towers. And by being reasonable, we discover ways of living in spite of the variations in moral behavior.<sup>18</sup> Hence, the Pyrrhonian arguments do not have to be taken seriously.<sup>19</sup>

The Pyrrhonist is not silenced by this commonsensical rejection of his arguments. He offers no rebuttal but instead presents a summary of the remaining materials of Sextus, Book I, the claims that everything is a matter of controversy, that every attempt to establish the truth of a theory leads to an infinite regress or to circular reasoning, and so on.<sup>20</sup> The alchemist offers the first rejoinder to this, pointing out that many of the alleged controversies are due to what stupid philoso-

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phers—deists, heretics, schismatics, and Rabelais—have said. And, in spite of the weird views of some people, as has been pointed out several times already, some matters are never actually disputed. No infinite regress occurs in explanations, because some matters are self-evident. Our knowledge of things can be shown to be reliable by our ability to verify predictions we make on the basis of what we know. Thus, for example, we predict that from our knowledge of the outside of a house there is an inside; and from our knowledge of the actions of the body, that there is a soul. Hence we can build up a science from evident maxims and from experience. Therefore, the Pyrrhonian conclusion is not necessary.

The Christian philosopher joins in at this point, saying that all that is needed to refute the skeptic is to produce some indubitable syllogisms, where the premises are generally accepted. After several examples are offered,<sup>21</sup> the Pyrrhonist counters by stating two arguments from Book II of "notre Sexte," the argument against the syllogism and the problem of the criterion. For a conclusion in a syllogism to be true, its premises must be true. To show the premises are true a proof is required; otherwise why accept the premises? This leads either to an infinite regress or to using the conclusions as evidence for the premises. Also, there is a vicious circle involved in syllogistic reasoning. The truth of the conclusion is shown from the truth of the premises. But the premises could not be known to be true unless the conclusion were antecedently known to be true (the problem later raised by J. S. Mill). Lastly, it has to be shown that there is a connection between the premises and the conclusion, and that there is a connection between the connection and the syllogism, and so on.

In addition, a judge and a criterion of judgment are needed to tell if something has been demonstrated. But who or what is to judge who or what the judge is? And on what criterion will it be decided what the criterion is? Our senses are unreliable. We cannot tell if understanding is to judge matters and so on. Until all this can be settled,

<sup>21</sup>Including the syllogism: Everything that passes from one place to another, moves; the sun passes from one place to another; therefore, the sun moves (*ibid.*, pp. 163-69).

<sup>22</sup>*Ibid.*, pp. 179-89.

<sup>23</sup>*Ibid.*, pp. 190-95.

<sup>24</sup>*Ibid.*, pp. 196-200.

<sup>25</sup>*Ibid.*, pp. 201-4.

we cannot know the true nature of things but only how they seem to us.<sup>22</sup>

The Christian philosopher answers the latest skeptical barrage by offering a pragmatic version of Aristotle's theory of the proper conditions for obtaining empirical and intellectual knowledge. Without giving any argument, Mersenne's spokesman announces that, in fact, man is the judge of truth and that each human sense is the judge of its own objects. When we perceive sunlight at midday, we know it is day, and no argument about criteria or judges makes any difference. By using our faculties properly, we will discover *maxims veritables*, which all people accept. It is not necessary to show indubitably what the criterion of truth is in order to be sure that these *maxims veritables* are true. As a matter of fact, our reasoning faculty is our criterion; and our sense information, our rules, and our instruments are judged by it. We are not confused by sense illusions, since, by using instruments like a compass and then by rationally evaluating the information obtained, we may reach our proper conclusions about the nature of objects.<sup>23</sup> The analysis does not disprove the skeptic's claims but only shows how the problem is, in fact, dealt with.

The various Pyrrhonian points about the validity of demonstrations are ignored, except for the charge that syllogisms always contain vicious circles. It is simply not the case, we are told, that the conclusions constitute some of the evidence for the premises. The conclusions may lead us to discover the premises but not to prove them.<sup>24</sup> The evidence for the premises is either inductive from other materials than the conclusion or is the self-evidence of the premises. If the skeptic actually doubts that there are premises that "ravish" the understanding and lead it to certain conclusions, can he doubt also that he knows that he doubts? If he doubts this, can he doubt that he doubts, and so on? No matter how the skeptic turns, Mersenne's spokesman insists, he will have to admit that something is true. Hence—"it is necessary to bid an eternal good-bye to your Pyrrhonism."<sup>25</sup>

The skeptic makes no reply but instead digresses to consider some views of Francis Bacon. The disputants then discuss whether Bacon is right in rejecting the syllogism. Mersenne criticized the English philosopher for being sometimes too skeptical and sometimes not

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skeptical enough. The force of the Idols depends on imitating the skeptics. But these kinds of arguments can be answered, we are told (presumably as has previously been done against the Pyrrhonists.) On the other hand, Bacon's positive procedures for discovering the truth are unworkable. First of all, they are not based on what occurs in contemporary science; but more important, in analyzing experience, we never actually find the true nature of things, as Bacon hoped we would. No matter what phenomena we consider, we cannot penetrate to the inner natures of things because our senses, without which our understanding knows nothing, perceive only the external characteristics of objects.<sup>26</sup> Hence, the schemes of Francis Bacon can be set aside.

The first book of *La Verité des Sciences* concludes with a few further comments on Sextus, dealing with his views on physics and metaphysics, which are written off as captious, sophistic, and too feeble to require refutation. The alterations in material things do not prevent us from knowing something, since we know at least that there are alterations. And by employing proper precautions, we can diminish the possibility of sense deceptions about these matters.<sup>27</sup> Hence, one must not suspend judgment. One must accept the truth as the greatest treasure that one can receive. If not, one will live in perpetual darkness with no consolation.<sup>28</sup>

After the first book treating the problems of skepticism, Mersenne turned to his ultimate refutation of Pyrrhonism—a confrontation of the skeptic with the truths that are known. Although the skeptical difficulties may be fundamentally unanswerable, a pragmatist solution to the problem may be possible. When one examines the amazing quantity and structure of things known, can one still remain a skeptic? And so, approximately the last eight hundred pages of *La Verité des Sciences* is a list of what is known in mathematics and mathematical physics, matters on which there is no need for suspense of judgment. Arithmetic, geometry, and other branches of mathematics are de-

<sup>26</sup>"Or quelques Phenomenes qu'on puisse proposer dans la Philosophie, il ne faut pas penser que nous puissions pénétrer la nature des individus, ni ce qui se passe interieurement dans iceus, car nos sens, sans lesquels l'entendement ne peut rien conoître, ne voyent que se qui est exterieur" (*ibid.*, p. 212). The discussion

of Francis Bacon is on pp. 205-18.

<sup>27</sup>*Ibid.*, p. 219.

<sup>28</sup>*Ibid.*, p. 220.

<sup>29</sup>*Ibid.*, p. 730.

<sup>30</sup>*Ibid.*, p. 751.

<sup>31</sup>Lenoble, *Mersenne*, p. 32.

<sup>32</sup>*Ibid.*, pp. 310-33.

veloped and examined. Some rather amazing digressions occur into the philosophy of mathematics, the source of mathematical truths, and the relation of mathematics to nature and to God. The effect of this presentation of the body of then known mathematical disciplines is to silence the skeptic's doubts completely and to force him "to say adieu to Pyrrhonism."<sup>20</sup> The skeptic has discovered in mathematics the most excellent means of overturning all his arguments and returning him to common sense.<sup>20</sup>

What is the character of this refutation of skepticism that Mersenne labored upon so long? Lenoble has described it as akin to Diogenes's refutation of Zeno's denial of motion, by merely walking around.<sup>21</sup> Pyrrhonism has been rebutted not so much by answering its arguments as by exhibiting what we know. Lenoble argues that this is a genuine refutation that contains the basis for the modern "scientific outlook," in that Mersenne considered science as the study of phenomenal relationships apart from any metaphysical foundation or causes.<sup>22</sup> I shall argue instead that Mersenne did not actually refute Pyrrhonism but rather adopted a form of it, a constructive skepticism in opposition to the destructive humanistic Pyrrhonism of some of his friends. And it is this constructive skepticism rather than any refutation of the Pyrrhonian arguments which forms the basis of the "scientific outlook."

In various works, Mersenne admitted to a kind of "epistemological" Pyrrhonism. In *La Verité des Sciences* he never claimed that we possess any true knowledge, in the sense that we know either some absolutely certain first principles or some knowledge demonstrated from them. The "real" natures of things are always hidden and cannot be uncovered. When not attacking skeptics, Mersenne could say this quite bluntly. In his *Les Questions Theologiques, Physiques, Morales, et Mathematiques* (Paris, 1634), it is argued that a science of eternal truths is not possible and that the summit of human wisdom is the realization of our own ignorance. One will always have to confess that he knows no satisfactory reasons for his beliefs, nor can one give any that are so certain that they cannot be doubted. This may discourage and silence wise men and make them despair of ever reaching any infallible knowledge of the works of nature or of things

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in themselves. No wise man would pretend to know any subject with sufficient evidence and certainty to be able to establish a science of it. For we perceive only the outside, the surface of nature, and can never know the interior. We can only have a science of the external effects of things, without ever being able to know the reasons for them, unless it pleases God to deliver us from this misery by giving us illumination.<sup>83</sup>

The same skeptical view is presented in the *Questions Inouyes ou Recreation des Sçavans* (Paris, 1634), in answer to the question (XVIII), "Can one know anything certain in physics or mathematics?" In physics not even the causes of the most common effects can be known, like the causes of light, of falling bodies, and so on. It cannot even be demonstrated that the world we see is not just mere appearance. And hence Mersenne concluded that "there is nothing certain in physics, or there are so few things certain that it is difficult to state them."<sup>84</sup> In the realm of mathematics, truths are only conditional; that is, if there are objects like triangles, then the geometrical theorems are true.<sup>85</sup>

The refutation of skepticism offered by Mersenne never denies this fundamental epistemological Pyrrhonism. The appeal in *La Verité des Sciences* is to two claims, one that in spite of the force of the skeptical arguments, we have means for deciding many of the problems at issue, and the other, that in spite of all the insoluble doubts, we do in fact possess a type of knowledge that cannot actually be questioned. The first book of *La Verité des Sciences* sets forth a type of pragmatic solution to the Pyrrhonian tropes and other skeptical difficulties. Practical means are offered, such as the employment of optical rules. Common-sense observations show how we do in fact settle any philosophical disproof of the claims of the skeptics. The

<sup>83</sup>"Car l'on peut dire que nous voyons seulement l'écorce, & la surface de la nature, sans pouvoir entrer dedans, & que nous n'aurons jamais autre science que celle de ses effets extérieurs, sans en pouvoir penetrer les raisons, & sans sçavoir la maniere dont elle agit, jusques a ce qu'il plaise à Dieu de nous delivrer de cette misere, & nous dessiller les yeux par la lumiere qu'il reserve à ses vrais adorateurs" (p. 11; see pp. 9-11).

<sup>84</sup>"Il n'y a rien de certain dans la Physique, ou qu'il y a si peu de choses certaines, qu'il est difficile d'en proposer" (p. 71; see pp. 69-71).

<sup>85</sup>*Ibid.*, pp. 72-74.

<sup>86</sup>Charles Adam, "Vie de Descartes," *Oeuvres de Descartes*, ed. Adam and Tannery (Paris, 1910), xii, 131.

<sup>87</sup>Mersenne, pp. 321 ff.

remainder of *La Verité des Sciences* is a compendium of the vast body of truths that are actually known in the mathematical disciplines, which no honest skeptic can doubt if he understands them.

But does this constitute a refutation of skepticism? Charles Adam argued that it does not because Mersenne had never questioned the scientific laws that he employed in answering the Pyrrhonists.<sup>36</sup> Lenoble contended that Mersenne actually did refute skepticism by cutting the ground out from under the Pyrrhonian objections. By rejecting the demand for a metaphysical basis for scientific knowledge, Mersenne has demolished the force of skepticism.<sup>37</sup> I submit that Mersenne's science without metaphysics is fundamentally a kind of skepticism, which he recognizes. The philosophy of science presented by Mersenne depends first upon admitting that no grounds can ever be given for our knowledge. We have no way of telling if our information corresponds to reality or if our knowledge is like God's. Once this has been recognized, we can then systematize what we know into laws about appearances and thus develop sciences of phenomena. This new type of science, advocated by both Mersenne and Gassendi, was not what previous philosophers had sought—a science of reality. Instead it was what remained after one had admitted that the skeptics were correct in doubting that any science of reality could ever be discovered. The skeptical arguments lose their force by being accepted and not by being disproved. Once the full strength of the Pyrrhonian onslaught has been granted, the ground has been cut from under dogmatism rather than skepticism. What has been added by Mersenne, however, is a new ending to an old story, a “justification” of a new kind of science based upon a complete doubt of the possible discovery of any ultimate principles.

One finds in Mersenne a paradoxical attitude towards skepticism which reflects the temper of his age—the era of intellectual revolution. On the one hand we see Mersenne violently denouncing Pyrrhonism and the Pyrrhonists, and on the other we see him as a kind of theoretical Pyrrhonist (and an intimate friend of the practicing Pyrrhonists, La Mothe Le Vayer, Naudé, Sorbière and the young Gassendi). This ambivalence illustrates a basic quest of seventeenth-century thought

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for a *via media* between complete skepticism and indefensible dogmatism.<sup>38</sup>

In spite of the many criticisms voiced by opponents, skepticism had swept the field, the skepticism of Montaigne, Charron, the recently rediscovered Sextus Empiricus, and the early Gassendi, joined with the impact of late medieval nominalism and the fideistic Aristotelianism of Pomponazzi and the Paduans.<sup>39</sup> Many thinkers who lived in the mainstream of thought of the period had been overwhelmed by the tide of skepticism and had accepted as a basic fact the view that nothing is completely certain in any field of inquiry. If the force of the prevailing skepticism were once admitted, what would then follow? Presumably the logical outcome of the whole matter would be the application of the skeptical outlook to practice, with devastating

<sup>38</sup>See for instance, Blaise Pascal, *Pensées*, ed. Brunschwig, introd. by Ch.-M. Des Granges (Paris, 1951), #434, pp. 183-86; Jacques Du Bosc, *Le philosophe indifférent* (Paris, 1643), Deuxième partie, pp. 1123-24; and Petrus Gassendi, *Syntagma Philosophicum, Logica*, II, v, in *Opera Omnia* (Lyon, 1658), I, 79.

<sup>39</sup>Cf. Alan M. Boase, *The Fortunes of Montaigne* (London, 1935); Henri Busson, *La Pensée Religieuse Française de Charron à Pascal* (Paris, 1933); René Pintard, *Le Libertinage Érudit dans la première moitié du XVII<sup>e</sup> siècle* (Paris, 1943); Julien-Eymard D'Angers, *Pascal et ses Précurseurs* (Paris, 1954); and R. H. Popkin, "The Sceptical Crisis and the Rise of Modern Philosophy," *Review of Metaphysics*, VII (1953-54), 133-51, 308-22, and 499-510.

<sup>40</sup>This is not to suggest that Descartes was a Thomist but rather that he was seeking the type of foundation that medieval thinkers had sought. The old ways had collapsed. Descartes was offering a new way to satisfy old conditions.

<sup>41</sup>I use this term to designate a group of Pyrrhonists who couple their Pyrrhonian attitude with certain anti-intellectualistic strains of humanism, and who are interested primarily in humanistic rather than scientific questions.

<sup>42</sup>See, for instance his *Discours pour montrer que les Doutes de la Philosophie Sceptique sont de grand usage dans les*

*sciences*, in *Oeuvres de François de La Mothe Le Vayer* (Paris, 1669), xv, 61-124, where he argues that skepticism will make one see the futility and arrogance of scientific research, and then maybe one will give it up. (It should be noted that La Mothe Le Vayer is oblivious of the scientific revolution going on around him and is thinking of science in the sense of Aristotle or Democritus.)

<sup>43</sup>This interpretation of Sorbière will be developed in a projected study of the author. An interesting comment on this attitude of Sorbière's appears in Thomas Sprat's *Observations on Monsieur de Sorbière's Voyage into England* (London, 1665), pp. 275-6, when Sprat criticizes Sorbière for being so positive that English food was bad. "But yet I must tell him, that perhaps this Rigid condemning of the *English Cookery*, did not so well suit with his belov'd Title of *Sceptick*. According to the laws of that profession, he should first have long debated whether there be tast, or no; whether the steam of a pot be only a fancy, or a real thing; whether the Kitchen fire has indeed the good qualities of roasting, and Boiling, or whether it be only an appearance. This had bin a dispute more becoming a *Sceptick*, than thus to conclude Dogmatically on all the Intrigues of *Haut gousts*; and to raise an endlesse speculative quarrel between those that had bin hitherto peaceful and practical *Sects*, the *Hashe's* and the *Surloiners*."

and enervating results. But could one be a complete Pyrrhonist in practice as well as theory? There might be no foundation for human knowledge. *Que faire?* To be a dogmatist, a defender of this knowledge, required building an unconstructible foundation for it. Only a determined, unregenerate medieval mind like that of René Descartes<sup>40</sup> was ready to save the dogmatic outlook by offering a towering edifice of human knowledge, built upon an “unshakeable” foundation, to replace the withered and rotted dogmatism of the late Scholastics. Others, lacking, perhaps, the heroic attitude of Descartes, could only see the human tragedy of man lost between an indefensible dogmatism and an unacceptable skepticism, seeking desperately for some new solution, some *terra incognita*, which could receive as peaceful neighbors theoretical Pyrrhonism and the knowledge that men had acquired.

This quest for stability rather than certainty goes on in varying degrees in many seventeenth-century minds, including that of Mersenne. The existence of scientific and mathematical knowledge makes one say *adieu au Pyrrhonisme*, and yet the skeptical arguments show that a necessarily true science of reality cannot be discovered. The thoroughgoing skeptics who wish to make their practice consistent with their theory are willing to say *adieu aux sciences* and throw out all human knowledge. The humanistic Pyrrhonists<sup>41</sup> like François de La Mothe Le Vayer, the intellectual and spiritual heir of Montaigne, let their skepticism lead to a jesting and jeering attitude toward all intellectual endeavours.<sup>42</sup> Perverse skeptics like Samuel Sorbière seem to be trying to live the life of Pyrrho incarnate by pretending to make no judgments about intellectual matters.<sup>43</sup> But Father Mersenne—and in later years, his closest friend, Father Gassendi—could not, nor did they wish to, dispense with the achievements of mankind in the search for religious and scientific knowledge. Hence the quest. They find a solution only in the pragmatic and positivistic interpretation of science.

Some further indications of Mersenne's attitude of “constructive skepticism” can be found in his correspondence. Mersenne's friends seem to be aware that Pyrrhonism is a very touchy subject with him, and yet they are aware that, although the very mention of the term

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may arouse him, it is nevertheless the case that Mersenne is a type of skeptic. The veteran anti-Pyrrhonist, Pierre Le Loyer, chided Mersenne for his skepticism while adding that he knew that Mersenne was not a Pyrrhonist.<sup>44</sup> Gassendi, in his letter to Mersenne in his attack on the Rosicrucian, Robert Fludd, made a similar point. After first confessing to a skepticism which he knew annoyed Mersenne and which he claimed Mersenne forbade him to hold, Gassendi offered a compromise—that they, in their daily lives, accept views only on a probable basis.<sup>45</sup>

An extended discussion of Mersenne's attitude towards skepticism was offered by La Mothe Le Vayer, an account which aids in evaluat-

<sup>44</sup>"Je voy qu'estes sectateur de la seconde Academie et de Cameade, lequel de quelque chose proposée et mise en dispute, estimoit qu'on pouvoit discepter probablement; et j'embrace l'opinion de Varron, qui tenoit pour la premiere Academie, de laquelle ne diferre la seconde sinon de parolles et non d'effaict. Ce n'estoit pas comme la seconde, laquelle estoit d'Arcesilaus et approchoit fort des philosophes Pyrrhoniens, de laquelle je scay qu'estes aultant esloigné que vous estes proche de la philosophie Platonienne . . ." (Pierre Le Loyer à Mersenne, 13 February, 1627, in *Correspondance du P. Marin Mersenne*, publiée par Mme. Paul Tannery, ed. Cornelis de Waard avec la collaboration de René Pintard [Paris 1932], I, 521).

<sup>45</sup>" . . . et non ignoras tenue scepticumque meum ingenium vix posse quidpiam exerere, quod tibi probe satisfaciatur. . . . Tametsi enim tu me fere Pyrrhonium esse prohibes sicque semper urgere soles, quasi aliquid habeam quod dogmaticus proferam, vicissim tamen amicitiae jure illud debes concedere, ut vivere in diem liceat et nihil unquam vel efferre vel excipere praeter fines merae probabilitatis" (Pierre Gassendi à Mersenne, 4 February, 1629, in *Correspondance du P. Marin Mersenne* [Paris, 1937], II, 184-85).

<sup>46</sup>In Mersenne, *Questions Harmoniques. Dans lesquelles sont contenues plusieurs choses remarquables pour la Morale, & pour les autres sciences* (Paris, 1634), pp. 84-165.

<sup>47</sup>"Je n'ay point fait difficulté de me jouer avec vous des moyens de l'Epoque, sachant bien que vous ne les avez jamais improuvez dans les limites des sciences humaines, & que vous n'avez jamais blâmé la Sceptique lors que respectueuse vers le Ciel, & captivant sa ratiocination sous l'obeissance de la foy, elle s'est contétée d'attaquer l'orgueil des Dogmatiques par l'incertitude de leurs disciplines. Une mesme espée peut servir à un meschant pour commettre un infame homicide, & estre l'instrument d'une action heroïque dans la main d'un homme vertueux. Celuy qui met les choses divines à l'examen du Pyrrhonisme est aussi condamnable, qu'un autre peut estre estimé, de se former des notions, qui luy representent la plus grande sagesse mondaine, une espece de folie" (*ibid.*, pp. 161-62).

<sup>48</sup>"Quam libenter illi tuae Epochae et Scepticis naeniis renuntiaturus es, cum Dogmaticam firmissimis innixam fulcris fateri cogeris" (Mersenne à Sorbière, 25 April, 1646, printed in Gaston Sortais, *La Philosophie Moderne depuis Bacon jusqu'à Leibniz* [Paris, 1922] II, 214-15). Mersenne's comments on *De Cive* are only of the highest praise. Gassendi at least noticed the irreligious slant, though highly approving of Hobbes's work. Descartes, on the other hand, vehemently condemned *De Cive* for basing its analysis on "maximes, qui sont tres-mauvaises et tres-dangereuses" Cf. Sortais, *La Philosophie Moderne*, pp. 214-16; and Lenoble, *Mersenne*, pp. 576-78.

ing the peculiar character of Mersenne's views. In the latter's *Questions Harmoniques*, in the section "Is Music a Science, and Does It Have Evident and Certain Principles?" Mersenne printed La Mothe Le Vayer's *Discours Sceptique sur la Musique*.<sup>46</sup> After giving various reasons for being skeptical about the achievements of music and musicians, La Mothe Le Vayer ended on a personal note, in a post-script to Mersenne, claiming an accord between his skepticism and his friend's views. Mersenne, La Mothe insisted, had never blamed the skeptics for attacking the pride of the dogmatists, provided that the skeptics were also obedient to the faith and did not extend their doubts into religion. Skepticism is a weapon that can be used for good or evil purposes. The Pyrrhonist who casts doubt on divine matters is wicked, whereas the one who shows that the greatest worldly wisdom is a kind of foolishness is performing a beneficial service that Mersenne and the skeptic can both applaud.<sup>47</sup> La Mothe Le Vayer might have been overestimating the area of agreement that existed between himself and his friend Mersenne, but at least they would agree to use the skeptical sword to slay the pride of the dogmatist. Mersenne was, however, also worried about the other uses to which it might be put in religion and science. La Mothe Le Vayer was willing to exempt religious knowledge from his attacks, but for the rest he intended to remain in suspense of judgment rather than accept any dogmatic theory. Mersenne took one further step, that of accepting scientific knowledge without dogmatic grounds.

It is interesting that several years later Mersenne wrote to Sorbière concerning Hobbes's *De Cive*, telling him what a masterpiece it was, and that it would overthrow Sorbière's skepticism.<sup>48</sup> If one asks what Hobbes had discovered that could demolish Pyrrhonism, it is not that he had developed a metaphysical foundation for knowledge of man that was indubitable but rather (for Mersenne) that he had developed a science of man. Like the Pyrrhonist of *La Verité des Sciences*, Sorbière was expected to give up his doubts by being shown what can be known. But this would not make him a dogmatist in the sense of one who knows the true nature of things. Hobbes's science of man would still be compatible with the claim that we can never know any ultimate truths about reality.

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These glimpses of Mersenne's attitude indicate, I believe, that what he was fighting was not skepticism *per se* but a kind of reaction that might, and sometimes did, result from seeing that fundamentally every theory was open to question. This reaction might take the form of an antiscientific, humanistic skepticism, as it did with La Mothe Le Vayer and Sorbière, or might even extend further and become a religious skepticism, even atheism. The last step was, of course, anathema to Mersenne. But even the first stage he saw as dangerous, in that it amounted to a rejection of the one means God had given us to get through this vale of tears. The *crise pyrrhonienne* cannot be resolved, but at least by scientific endeavor we are able to live with it. Theoretical skepticism is good, and perhaps even necessary, in eliminating the pride of the dogmatists. Practical skepticism, in either religion or science, is a road to disaster.

Mersenne's "constructive Pyrrhonism" is not the scientistic way of answering skepticism. The latter view holds that the progress of scientific discoveries, theories, and so on, has made the original reasons for doubting ridiculous because we have by now uncovered, or will shortly uncover, the real world. Mersenne, on the other hand, saw that the progress of science in no way disproved Pyrrhonism, unless the Pyrrhonist was foolish enough, or impious enough, to doubt the scientific achievements *as well as* the grounds for them. The latter had to be doubted, and the former had to be accepted. "La vérité des sciences" does not overthrow total theoretical skepticism but is the constructive issue from it.

## PHILOSOPHY IN ATOMIC PHYSICS: COMPLEMENTARITY

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### Introduction

The progressive scientific discovery of reality by means of atomic physics raises new philosophic problems or gives a new significance to the old philosophic views and interpretations of the material world. Both philosophers and physicists are well aware of this fact, as is evidenced by the ever-renewed interest shown by scientists in philosophic discussions and, conversely, by philosophers in scientific progress. At the Fourth International Thomist Congress (Rome, Sept. 13-17, 1955), issues raised by modern science were discussed by philosophers. One of the outstanding features of the Congress was precisely the agreement on the need of co-operation between scientists and philosophers. The Pope himself, in his address expressed the feeling of all the participants:

You know how advantageous and necessary it is for a philosopher to deepen his own understanding of scientific progress . . . It is only by means of mutual understanding and cooperation that there can arise a great edifice of human knowledge that will be in harmony with the higher light of divine wisdom.<sup>1</sup>

Yet the difficulties in the way of this desired understanding are great indeed. Philosophers, particularly, experience the difficulty of having to face a hardly digestable technical knowledge before they are able to fully grasp the import of the physicists' statements on philosophic matters. An attempt, therefore, to gather and analyze the latter's ideas on problems of common interest and thus make physicists' mentality more accessible to philosophers could well contribute to the desired mutual understanding.

One of the problems raised by microphysics is complementarity, which seems to draw general notice from philosophers. In writing of it here, I should like to present and discuss the facts and mathematical theories of microphysics in the light of their interpretation as given by leading physicists; and I should like to call attention to the philosophical aspects involved and point out the implications that require further discussion.

Complementarity, which claims to be the scientific principle able to solve the wave-corpuscle and similar enigmas of microphysics, has a signification not easily grasped. The principle appears to issue immediately from experimental data, so that it has been possible to talk of the evidence of complementarity.<sup>2</sup> But there are also baffling features, because of which even some leading physicists feel dissatisfied with it.<sup>3</sup> To state the problem properly, therefore, it is necessary to start out from the facts and physical theory as well as an analysis

<sup>1</sup>*Catholic Mind*, LIV (Jan., 1956), 51.

<sup>2</sup>L. Rosenfeld, "L'Evidence de la complémentarité," *Louis de Broglie, Physicien et Penseur* (Paris: Albin Michel, 1953), pp. 43 ff.

<sup>3</sup>L. de Broglie attributes obscurity to Bohr, the author of the principle. (*La Physique quantique restera-t-elle indéterministe?* [Paris: Gauthier-Villars, 1953], p. 14).

A. Einstein avows having been unable "despite much effort" to achieve the sharp formulation of the principle of complementarity, which he is inclined to reject ("Reply to Criticisms," in *Albert Einstein, Philosopher-Scientist* ["The Library of Living Philosophers"; New York: Tudor, 1951], p. 674).

<sup>4</sup>Such a modellistic interpretation was typical of classical physics, that is, all physical theory preceding the new discoveries. The classical physicists' ideal was sharply outlined by H. A. Lorentz at the Solvay Congress (Bruxelles, 1927) where quantum physics eventually triumphed. "L'image que je veux me former des phénomènes doit être absolument nette et définie et il me semble que nous ne pouvons nous former une pareille image que dans le système de l'espace et du

temps. Pour moi, un électron est un corpuscule qui, à un instant donné, se trouve en un point déterminé de l'espace. Et si cet électron rencontre un atome et y pénètre et qu'après plusieurs aventures il quitte cet atome, je me forge une théorie dans laquelle cet électron conserve son individualité, c'est-à-dire que j'imagine une ligne suivant laquelle cet électron a passé à travers cet atome" (as quoted by J.-P. Vigié in *La Physique quantique restera-t-elle indéterministe?* p. 90).

<sup>5</sup>M. Born, *Atomic Physics* (London and Glasgow: Blackie, 1948), pp. 78 f.

<sup>6</sup>G. Herzberg, *Atomic Spectra and Atomic Structure* (New York: Dover, 1944), pp. 13 ff., esp. p. 15.

<sup>7</sup>W. Heisenberg, *Die physikalischen Prinzipien der Quantentheorie* (Leipzig: Hirzel, 1930), pp. 6 ff.

<sup>8</sup>Herzberg, *Atomic Spectra*, pp. 96 ff.

<sup>9</sup>"Es muss hervorgehoben werden, dass diese Aussagen ganz wörtlich zu nehmen sind und keineswegs nur 'symbolischen Charakter' haben. Denn es kann z.B. durch Stern-Gerlach Experimente festgestellt werden, in welchem stationären Zustand das Atom verweilt" (Heisenberg, *Die Prinzipien der Quantentheorie*, p. 61).

of the meaning of this theory, in which complementarity is the highest achievement.

## I. Experimental Evidence and Physical Theory

Explanation of material reality in terms of perfect models as the ideal of physical theory<sup>4</sup> was proved inadequate by a series of experimental discoveries beginning with the start of the present century.

Energy, in opposition to the classical conception, revealed a discrete structure. After Planck's discovery of the quantum of action, the first step in the new direction was Einstein's "heuristic" interpretation of the photoelectric effect. This consists in the fact that if light falls on a metal surface in a high vacuum, part of it is transformed into mechanical energy; negative electricity issues from the metal surface in the form of electrons. Now, all experimental results are intelligible only by admitting the idea that light consists of a hail of discrete bunches of energy (photons), a viewpoint difficult to reconcile with the classical theory that explained light in terms of continuous waves.<sup>5</sup>

Another new fact was the discovery of stationary states. Bohr succeeded in proving the discrete structure (quantization) of energy by means of the stationary states of the atom. Although still classical-minded and with apparent contradictions, his theory broke loose from many classical laws. The atom consists of a heavy nucleus, positively charged, about which electrons, negatively charged, rotate on fixed orbits. Radiant energy is emitted or absorbed as light quanta by a transition of the electron from one stationary state to another.<sup>6</sup> Experiments by Franck-Hertz<sup>7</sup> in 1914 confirmed the existence of stationary states in atoms. Similarly other experiments by Stern-Gerlach in 1921 demonstrated also the space quantization of atoms. The total angular momentum of the atom is space quantized in a magnetic field; that is, the angular momentum vector can take only certain discrete directions in a magnetic field.<sup>8</sup> Quantum or discrete states of energy were therefore proved beyond any doubt.<sup>9</sup> But more startling facts were to be revealed.

Light, besides its well-established wave character, has a corpuscular behavior. The Compton effect proves it by the laws of frequency

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change in the scattering of X-rays.<sup>10</sup> Further experimental tests found that the light corpuscular theory is thoroughly in accord with facts. The photon-electron collision can even be visualized in the Compton-Simon experiment. Radiation definitely behaves like a corpuscle.<sup>11</sup>

Matter, on the other hand, not only has evident corpuscular properties but has also a wave behavior. Surprising evidence was obtained by Davisson and Germer almost casually. Electrons, accelerated against a nickel crystal, showed selective reflection, just as X-rays, whose wave nature was absolutely certain. Countless experiments were instituted to investigate this unsuspected feature of material particles. They were found to have a behavior completely analogous to that of light quanta.<sup>12</sup>

Both light and material particles show a consistent double aspect in experiments. Whenever we are dealing with a single elementary process—for instance, an electron impinging on a screen—we must predominantly use the particle concept to describe experimental findings; but when we are dealing with a huge number of microevents—for instance, an electron stream passed through a thin metal foil—in order to describe the experimental situation we must predominantly use the wave theory.

Now, usual models of classical physics proved completely inadequate to cope with the new situation. Apart from other difficulties, the failure of such schemes is strikingly evidenced by the wave-corpuscle riddle. No classical interpretation of it can be thought of

<sup>10</sup>Born, *Atomic Physics*, pp. 82 ff.

<sup>11</sup>"In the Compton scattering we have therefore a typical example of a process in which radiation behaves like a corpuscle of well-defined energy (and momentum); an explanation by the wave theory of the experimental results which we have described seems absolutely impossible" (Born, *ibid.*, p. 84).

<sup>12</sup>S. Flügge-A. Krebs, *Experimentelle Grundlagen der Wellenmechanik* (Leipzig und Dresden: Steinkopf, 1936), p. 154.

<sup>13</sup>A. Einstein-L. Infeld, *The Evolution of Physics* (Cambridge Univ. Press, 1938), pp. 278 ff.

<sup>14</sup>In Schrödinger's words: "Est ist . . . ziemlich wahrscheinlich, dass die Anpassung des Denkens an die Erfahrung ein infiniter Prozess ist und dass 'vollkommenes Modell' einen Widerspruch im

Beiwort enthält, etwa wie 'grösste ganze Zahl'" ("Die gegenwärtige Situation in der Quantenmechanik," *Die Naturwissenschaften*, xxxiii [1935], 808).

<sup>15</sup>Schrödinger demonstrated the physical equivalence of the two theories. (Cf. *Mémoires sur la mécanique ondulatoire* [Paris: Alcan, 1933], pp. 71 ff.).

<sup>16</sup>"Die Unbestimmtheitsrelationen beziehen sich auf den Genauigkeitsgrad unserer gegenwärtigen (gleichzeitigen) Kenntnis der verschiedenen quantentheoretischen Grössen. Da diese Relationen nicht die Genauigkeit z.B. einer Ortsmessung allein oder einer Geschwindigkeitsmessung allein beschränken, so äussert sich ihre Wirkung nur darin, dass jedes Experiment, das eine Messung etwa des Ortes ermöglicht, notwendig die Kenntnis der Geschwindigkeit in gewissem Grade

without incurring inextricable difficulties. To prove this point, let us discuss a simple example, light diffraction (the same considerations can be made about material particles). A beam of homogeneous light passing through a pinhole produces bright and dark *rings* on a screen. Now in order to explain the phenomenon in terms of corpuscles (photons), since there is no rectilinear propagation, one could only imagine that there is some interaction between the rim of the hole and the photons responsible for the appearance of the diffraction rings. But even this feeble hope for an explanation is dashed by experimental evidence. In fact, if there are two pinholes instead of one, homogeneous light passing through them gives bright and dark *stripes* on the screen. In terms of photons we must say that a photon has passed through either one of the two pinholes, for we cannot think of its division and the passage through the two holes simultaneously. But then the effect should be exactly the same as in the first case. "Apparently the hole through which the photon does not pass, even though it may be at a fair distance, changes the rings into stripes!"<sup>13</sup> In a few words: If the photon should behave like a corpuscle of classical physics the phenomenon of diffraction would be incomprehensible.

The conclusion, as a consequence of a thorough analysis of all new facts, has general validity: the classical ideal of a perfect model—either corpuscle or wave—had to be modified.<sup>14</sup>

Physicists were confronted with the quantum riddle. They solved it brilliantly along the two main directions of matrix mechanics and wave mechanics, both theories, although based on different considerations, being identical in content.<sup>15</sup>

Heisenberg and Bohr started out by clarifying the notion of a problem with a physical meaning. What do we mean when we speak of the description of a process in terms of corpuscles or in terms of waves? Are we right in assuming that these entities actually exist in microphysics as we imagine them? The answer to such questions can obviously be obtained only by having recourse to experience. Now this (Heisenberg's uncertainty relations<sup>16</sup>) teaches us that in the case of microentities it is impossible to determine more than one at a time of the typical properties of either corpuscle or wave. Consequently it

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is impossible to conclude that microentities are actually corpuscles or waves in the usual sense of the term, and we are not entitled to attribute to them imaginable properties of the macroworld. Thus a new methodological principle was formulated by the two physicists: "If a logically consistent system of atomic mechanics is to be set up, no entities may be introduced into the theory except such as are physically observable." Based on such requirement, Heisenberg was able to lay down the principles of matrix mechanics, later developed by himself, Jordan, and Born. The theory was completely successful in all its applications; particularly it accounted for those spectroscopical data in connection with which Bohr's atomic model had failed.

Wave mechanics, on the other hand, started from a "strange" physical intuition. L. de Broglie,<sup>17</sup> before direct experimental data were available to confirm his idea, thought of the possibility of connecting the propagation of a wave to the movement of a corpuscle. By cleverly taking advantage of Einstein's special relativity and Planck's quantum law he succeeded in giving the mathematical relation between the velocity of the corpuscle and the length of the associated wave.<sup>18</sup> Schrödinger, then, stimulated by De Broglie's work, developed the theory in its fullness. The author's great merit consisted in deducing all logical conclusions from the long-known fact,

stört. Nehman wir z.B; an, dass die Geschwindigkeit des Elektrons genau bekannt sei, der Ort dagegen völlig unbekannt. Dann muss jede folgende Beobachtung des Ortes das Impulsmoment des Elektrons ändern; und zwar muss diese Aenderung um einen derartigen Betrag unbestimmt sein, dass nach Durchführung des Experiments unsere Kenntnis der Elektronenbewegung durch die Ungenauigkeitsrelationen beschränkt ist" (Heisenberg, *Die Prinzipien der Quantentheorie*, p. 15).

<sup>17</sup>Cf. *Introduction à l'étude de la mécanique ondulatoire* (Paris: Hermann, 1930), pp. 35 ff.

<sup>18</sup>In this connection it is worth noticing the factual foundation of all the procedure. "I think that not a single step [in wave mechanics] would have been possible if some necessary foothold in facts had been missing. To deny this would mean to maintain that Planck's discovery of the quantum and Einstein's theory of relativity were products of pure thinking. They were

interpretations of facts of observation, solutions of riddles given by Nature—difficult riddles indeed, which only great thinkers could solve" (Born, *Natural Philosophy of Cause and Chance* [Oxford: Clarendon Press, 1949], p. 90).

<sup>19</sup>"The way out of the difficulty was actually (though unexpectedly) found in the possibility . . . that in the Hamiltonian Principle we might also assume the manifestation of a 'wave-mechanism', just as we have been long accustomed to acknowledge it in the phenomena of light and in the governing principle enunciated by Fermat" (*Science and the Human Temperament*, p. 176).

<sup>20</sup>"Si les conceptions que j'ai énoncées en 1927 devaient un jour ressusciter de leurs cendres, ce ne pourrait être que sous la forme tronquée et inacceptable de l'onde-pilote" (*La Physique quantique restera-t-elle indéterministe?* p. 12).

<sup>21</sup>*Atomic Physics*, pp. 90 f.

first discovered by Hamilton, of the striking similarity between classical mechanics and geometrical optics. Fermat's principle states that a light ray travels between two points along such a path that the time taken is the least. The mechanical principle of least action says that of all paths possible between two points, consistent with conservation of energy, the system moves along that particular path for which the time of transit is the least. Now Fermat's principle can be understood only by means of the wave theory of light. What about the least-action principle? Schrödinger solved the riddle by admitting, also for material particles, a wave mechanism.<sup>19</sup> Thus wave mechanics, a fine theory whose positive features were evident, was born. Many difficult aspects of atomic physics such as quantization of energy and uncertainty relations could now be accounted for in a simple, almost intuitive way (at least in the case of free particles), taking advantage of the well-known wave theory of classical physics.

Yet the mathematical solution of the quantum riddle had brought forward new difficulties. What was the physical interpretation, if any, of the wave function, obeying Schrödinger's equation? Schrödinger himself tried to interpret particles as wave packets—namely, as ensembles of plane, monochromatic waves with frequency and direction of propagation nearly equal. But this interpretation proved inadequate, for wave packets are not permanent in time and dissipate when diffracted. Another intuitive interpretation, the "pilot-wave," was suggested by L. de Broglie, but this idea also met with such difficulties that the author himself dropped it for good.<sup>20</sup>

The universally accepted interpretation of the wave function goes back to Born.<sup>21</sup> According to him, a mechanical process is accompanied by a wave process in which the intensity of the wave (square of the wave amplitude) gives the probability of finding microentities at any given point. The physical justification for such a theory is obtained by comparing the behavior of light and that of an ensemble of particles. Light incident on small particles of dust, for instance, is scattered by them. Now, if instead of thinking light as continuous waves, we interpret it in terms of photons it is evident that the number of scattered photons must be proportional to the intensity of the light wave at the place concerned. Just the same in case of material par-

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ticles. An incident beam of electrons, for instance, is thought of as having a De Broglie wave associated with it. When it passes over an atom this wave produces another spherical wave; analogy with optics leads one to admit that a quadratic expression formed from the wave amplitude should be interpreted as the number of scattered particles. Now the probability interpretation is physically highly significant. By carrying out the calculations it was found that the new idea led to the same result as classical Newtonian mechanics in the case of the scattering of alpha-rays by nuclei and completely agreed with Rutherford's experimental results. Many other scattering processes were later on subjected to the same calculations by Born, Bethe, and Mott, and results were always found in good agreement with experiments.<sup>22</sup> On the conceptual level the importance of the probability interpretation is expressed by the author himself in the following words:

It consists in the recognition that the wave picture and the corpuscle picture are not mutually exclusive, but are two complementary ways of considering the same process—a process whose accessibility to intuitive apprehension is never complete, but always subject to certain limitations given by the principle of uncertainty.<sup>23</sup>

In the new interpretation, both aspects, wave and corpuscle, are equally real. "For both are but two different projections of one and the same reality, both are inseparable from each other, and both together only give the complete description of the object considered."<sup>24</sup>

<sup>22</sup>Born, *ibid.*, p. 90. Born, "The Interpretation of Quantum Mechanics," *British Journal for the Philosophy of Science*, IV (1953), pp. 104 f.

<sup>23</sup>Born, *Atomic Physics*, p. 144.

<sup>24</sup>W. Heitler, "Departure from Classical Thought in Modern Physics," *Albert Einstein*, p. 194.

<sup>25</sup>"... von so ausgezeichnete Güte wie sie selten in der Physik wiederkehren" (Flügge-Krebs, *Experimentelle Grundlagen*, p. 20). J.-J. Trillat, *Les preuves expérimentales de la mécanique ondulatoire* (Paris: Hermann, 1934).

<sup>26</sup>Bohr, *La Théorie atomique et la description des phénomènes* (Paris: Gauthier-Villars, 1932), pp. 105 f.

<sup>27</sup>"... l'insuffisance des méthodes existantes vis-à-vis du problème des particules élémentaires apparaît dans leur

inaptitude à fournir une justification univoque du 'principe d'exclusion' établi par Pauli . . . En effet, ce principe, dont les conséquences sont si importantes pour le problème de la constitution des atomes ainsi que pour le récent développement des théories statistiques, ne se présente que comme une possibilité parmi plusieurs autres imaginables . . ." (*ibid.*, pp. 83 f.)

<sup>28</sup>"The two great theories, relativity and quantum mechanics, both creations of the twentieth century, and both departing profoundly from the classical picture, stand as yet apart from each other. A great deal of work has been done to bring about their unification—and no doubt a certain amount of insight has been gained—but the final solution is still in abeyance. We are concerned with the behavior of

Confirmations of the physical theory of quantum mechanics were plentiful both on the experimental and conceptual level. Experimental tests were extremely satisfactory, "of such exceptional excellence as rarely happens in physics."<sup>25</sup> The technique of electronic diffraction is today so perfectly developed that it is used in industry as a substitute for earlier research methods with X-rays. One can even construct electronic lenses and microscopes, whose resolving power is much higher than that of optical instruments. On the conceptual level confirmations of quantum theory were no less gratifying. To them we can ascribe, first of all, the demonstration of compatibility between wave mechanics and classical mechanics. This simple but necessary result can be easily reached by taking into consideration the Hamilton-Jacobi equation of classical mechanics on one hand and the wave mechanics equation on the other. One comes to the conclusion that the relationship between the two theories is the same as that which holds between geometrical and wave optics. The latter, far from contradicting the former, is a richer theory, containing the former as limiting case. No wonder, therefore, that its explaining ability is far greater. Let it suffice to allude to the tunnel effect. According to classical mechanics the field of force surrounding the atomic nucleus should prevent alpha-particles from abandoning the nucleus. But experience shows that there are radioactive disintegrations. Quantum mechanics solved the enigma. The wave function representing the probability of presence of the particles is initially in the form of a wave packet entirely within the nucleus. The field of forces, although an obstacle for most material waves, let some of them "leak" through. The intensity of the wave leaking through the barrier gives the probability of disintegration of the atomic nucleus.<sup>26</sup>

Inadequacies, however, are to be recognized also in the quantum theory, at least insofar as its present form is concerned. To mention only a couple of cases, Pauli's principle, basic for understanding the periodic system of elements, remains unexplained;<sup>27</sup> and quantum mechanics is as yet a nonrelativistic theory—that is, it applies only to particles which move slowly and for which all gravitational effects can be neglected.<sup>28</sup> Inadequacies of this kind make more plausible the

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long, lively, thoroughgoing discussions of physicists on the interpretation of the physical theory.

## II. Physicists' Discussions on the Interpretation of the Theory

As long as a physical theory is concerned directly with facts—no

fast moving atomistic particles, with the structure of the fundamental particles themselves, electrons, protons, the newly discovered mesons, etc., their creation and annihilation: with an understanding of the elementary unit of the electric charge . . . We are as yet far away from a solution of these problems" (Heitler, "Departure from Classical Thought," p. 198).

<sup>28</sup>"The whole discrepancy is not so much an internal matter of physics, as one of its relation to philosophy and human knowledge in general. Any one of us theoretical physicists . . . confronted with an actual problem would use the same, or at least equivalent mathematical methods, and if we should obtain concrete results our prediction and our prescription for the experimental verification would be practically the same. The difference of opinion appears only if a philosopher comes along and asks us: Now what do you really mean by your words, how can you speak about electrons to be sometimes particles, sometimes waves, and so on? Such questions about the real meanings of our words are just as important as the mathematical formalism" (Born, "The Interpretation of Quantum Mechanics," p. 95). These words of Born, although directly concerning only his discussion with Schrödinger, well define the general problem we are to examine in this article.

<sup>30</sup>"The question at issue has been whether the renunciation of a causal mode of description of atomic processes involved in endeavours to cope with the situation should be regarded as a temporary departure from ideals to be ultimately revived or whether we are faced with an irrevocable step towards obtaining the proper harmony between analysis and synthesis of physical phenomena" (Bohr, "Discussion with Einstein on Epistemological Problems in Atomic Physics," *Albert Einstein*, p. 202).

<sup>31</sup>"Physics is an attempt conceptually to

grasp reality as it is thought independently of its being observed. In this sense one speaks of 'physical reality'" ("Autobiographical Notes," in *Albert Einstein*, p. 81). In a similar vein elsewhere: ". . . die Begriffe der Physik beziehen sich auf eine reale Aussenwelt, d.h. es sind Ideen von Dingen gesetzt, die eine von den wahrnehmenden Subjekten unabhängige 'reale Existenz' beanspruchen (Körper, Felder, etc.)" ("Quanten-Mechanik und Wirklichkeit," *Dialectica*, II (1948), 321).

<sup>32</sup>"Above all . . . the reader should be convinced that I fully recognize the very important progresses which the statistical quantum theory has brought to theoretical physics . . . This theory is until now the only one which unites the corpuscular and undulatory dual character of matter in a logically satisfactory fashion; and the 'testable' relations, which are contained in it, are, within the natural limits fixed by the indeterminacy-relation, *complete*" ("Reply to Criticisms," p. 666).

<sup>33</sup>*Ibid.*

<sup>34</sup>"What does not satisfy me in that theory, from the standpoint of principle, is its attitude towards that which appears to me to be the programmatic aim of all physics: the complete description of any (individual) real situation (as it supposedly exists irrespective of any act of observation or substantiation)" (*ibid.*, pp. 666 ff.).

<sup>35</sup>"Das Eigentümliche in der gegenwärtigen Situation sehe ich darin: Über den mathematischen Formalismus der Theorie bestehen keine Zweifel, wohl aber über die physikalische Interpretation ihrer Aussagen. In welcher Beziehung steht die  $\psi$ -Funktion zum konkreten einmaligen Sachverhalt, d.h. zu der individuellen Situation eines Einzelsystems? Oder: Was sagt die  $\psi$ -Funktion über den (individuellen) 'Real-Zustand' aus?" ("Elementare Überlegungen zur Interpretation der

matter how unfamiliar they might appear—and tries to give them a rational mathematical expression, physicists, to a man, work at the common task, sharing interests with enthusiasm and dedication. But when philosophic implications start being considered, dissensions crop up.<sup>29</sup>

Most famous among physicists' discussions on the interpretation of quantum mechanics is the Einstein-Bohr discussion.<sup>30</sup>

Einstein's thesis is that the description of physical reality given by the wave function (or  $\psi$ -function) is not complete. To state his viewpoint most clearly, Einstein usually first declares his strong conviction about physics' necessary realism<sup>31</sup> and takes pains to delimit the question as much as possible. He is in favor of wave mechanics as a physical theory,<sup>32</sup> admits the precise validity of the indeterminacy relations ("the correctness of which is, from my own point of view, rightfully regarded as finally demonstrated"),<sup>33</sup> but firmly rejects the interpretation commonly adopted by quantum physicists; namely, the conviction that the riddle of the double nature of all microentities (wave-corpusele or quantum riddle) has in essence found its final solution in the statistical character of quantum theory.<sup>34</sup> Briefly, to him the question at issue is one of interpretation.

The essential character of the present situation, it seems to me, is this: there are no doubts about the mathematical formation of the theory; there are some about the physical interpretation of its expressions. What is the relation between the  $\psi$ -function and the concrete individual reality, that is, the individual situation of a unique system? Or, in other words, what does the  $\psi$ -function tell us about the (individual) "real fact"?<sup>35</sup>

Besides the first skirmishes at the Solvay Congress of 1927, when Einstein insisted that a single microentity is localized though not localizable,<sup>36</sup> the author proposes two main arguments to prove his

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Grundlagen der Quantenmechanik," *Scientific Papers Presented to Max Born* [London: Oliver & Boyd, 1953], p. 33).

<sup>30</sup>Bohr, "Discussion with Einstein," pp. 201 ff. L. de Broglie, *Mécanique ondulatoire*, pp. 160 f.

thesis. First, the assumption that the description given by the wave function is complete leads to the hypothesis of action at a distance; secondly, quantum mechanics supplies no sufficient evidence of connection with classical physics at the macroscopic level.

For the first argument we have the celebrated paper by Einstein, Podolsky, and Rosen (containing an interesting definition of physical reality)<sup>37</sup> and two other articles.<sup>38</sup> In all of these writings Einstein wants to make the point that action at a distance is the necessary corollary of the hypothesis that the wave function description is complete. To this end he considers a physical system made up of two subsystems which interact only until the initial moment of the observation; from then on they are spatially separated. In this case, he points out, it is natural that one should speak of the real factual situation of subsystem one, absolutely independent of what happens in subsystem two. Yet, according to quantum mechanics, the scientist can get precise information on the state of subsystem one if he makes a measurement on subsystem two; and this information depends on what kind of measurement he undertakes on subsystem two. If he makes another kind of measurement on one subsystem, he gets very different information on the other partial system. This, Einstein maintains, can be admitted only if one accepts action at a distance, for only such a hypothesis can explain why, in consequence of the new disturbance caused by measurement on one subsystem, we find a new value for the corresponding magnitude on the other subsystem.<sup>39</sup>

As for the needed connection with classical mechanics, Einstein says that the probability interpretation is unsatisfactory because it does not give objective description of individual systems, not even

<sup>37</sup>"If, without in any way disturbing a system, we can predict with certainty (i.e., with probability equal to unity) the value of a physical quantity, then there exists an element of physical reality corresponding to this physical quantity" ("Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?" *Physical Review*, XLVII [1935], p. 777).

<sup>38</sup>"Quanten-Mechanik und Wirklichkeit," "Autobiographical Notes".

<sup>39</sup>"Fasst man die  $\psi$ -Funktion in der Quantenmechanik als eine (im Prinzip) vollständige Beschreibung eines realen Sachverhaltes auf, so ist die Hypothese

einer schwer annehmbaren Fernwirkung impliziert" ("Quanten-Mechanik und Wirklichkeit," p. 324).

<sup>40</sup>"Überlegungen zur Interpretation der Quantenmechanik," *Scientific Papers Presented to Max Born*, pp. 36 ff.

<sup>41</sup>"Reply to Criticisms," p. 671.

<sup>42</sup>Bohr, "Discussion with Einstein" pp. 214 ff.

<sup>43</sup>"Can Quantum-mechanical Description of Physical Reality Be Considered Complete?" *Physical Review*, XLVIII (1935), pp. 696 ff. "On the Notions of Causality and Complementarity," *Science*, CXI (1950), pp. 51 ff.

at the macroscopic level. To prove his point he considers a particle moving freely between impenetrable but perfectly reflecting and smooth walls,<sup>40</sup> and shows that by describing this physical fact in terms of wave functions it is incorrect to imagine that the particle is really moving back and forth between the walls, with a precise localization and a precise momentum at any given time. Consequently, one is induced to view the quantum description only as a statistical description of ensembles of systems.

Einstein's general conclusion of his criticisms against the commonly accepted interpretation of the wave theory is the following:

Within the frame-work of statistical quantum theory there is no such thing as a complete description of the individual system. More cautiously it might be put as follows: The attempt to conceive the quantum theoretical description as the complete description of the individual systems leads to unnatural theoretical interpretations, which become immediately unnecessary if one accepts the interpretation that the description refers to ensembles of systems and not to individual systems. In that case the whole 'egg-walking' performed in order to avoid the 'physically real' becomes superfluous.<sup>41</sup>

Against Einstein's untiring criticisms, Bohr repeatedly stresses the "orthodox" interpretation of quantum theory; namely, the theory that holds that the wave function, with its attendant probability interpretation, gives the only physically significant complete description of microphenomena.

At the Solvay Congress of 1927 he emphasized that—as far as micro-physics is concerned—it is wrong to say that a particle is localized though not localizable. To this end, Bohr with great skill proved all experimental arrangements suggested by Einstein inadequate to demonstrate such localization. Even more, he showed that one cannot think of the possibility of localizing quantum particles without destroying essential features of the phenomenon under consideration.<sup>42</sup>

In two other articles Bohr tries to show that both from the experimental and theoretical viewpoints Einstein's contention about the incompleteness of the description given by the wave function is unfounded.<sup>43</sup> He makes the point that the argumentation of Einstein,

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Podolsky, and Rosen not only does not affect the soundness of quantum mechanical description, but the wording of the above-mentioned criterion of physical reality suggested by the three authors contains an ambiguity as regards the meaning of the expression "without in any way disturbing a system." Actually it is true that by making a measurement on one of the two subsystems, the experimenter, at least in principle, can get information on the initial state of the other; but there is nothing unreasonable in this result, if we take into account the fact that the two subsystems, because of their former interaction, somehow may be considered as one system. However, there is no question of action at a distance. For of the two possible measurements the experimenter has the choice of making upon either of the subsystems only one can be actually carried out, since they are mutually exclusive. Therefore the proposed criterion of physical reality is ambiguous.<sup>44</sup>

As a general conclusion to the discussion it is worth comparing the opposite viewpoints of the two scientists. Einstein thus sums up his attitude against the commonly accepted interpretation of quantum mechanics about the completeness of the description given by the wave function:

<sup>44</sup>"Of course there is . . . no question of a mechanical disturbance of the system under investigation during the last critical stage of the measuring procedure. But even at this stage there is essentially the question of *an influence on the very conditions which define the possible types of predictions regarding the future behaviour of the system*. Since these conditions constitute an inherent element of the description of any phenomenon to which the term 'physical reality' can be properly attached, we see that the argumentation of the mentioned authors does not justify their conclusion that quantum-mechanical description is essentially incomplete" ("Discussion with Einstein," p. 234). Pauli also agrees with Bohr in condemning Einstein's thesis ("Editorial," *Dialectica*, II [1948], pp. 308 f.).

<sup>45</sup>"Reply to Criticisms," p. 672.

<sup>46</sup>"Discussion with Einstein," p. 235.

<sup>47</sup>"A Discussion of Certain Remarks by Einstein on Born's Probability Interpreta-

tion of the Quantum Theory," *Scientific Papers Presented to Max Born*, pp. 13 ff.

<sup>48</sup>"In conclusion the author would like to state that he would admit only two valid reasons for discarding a theory that explains a wide range of phenomena. One is that the theory is not internally consistent, and the second is that it disagrees with experiment. Principles and requirements such as those suggested by Einstein frequently serve as valuable heuristic aids, when they are used in the search for a *positive* theory. But when they are used to *discard* a logically consistent theory that agrees with all known experimental facts, then they may lead to another form of precisely that subjectivism which Einstein finds unsatisfactory in Born's interpretation of the quantum theory" (*ibid.*, p. 18).

<sup>49</sup>"Are there Quantum Jumps?" *British Journal for the Philosophy of Science*, III (1952), 109 ff.; 235 ff.

Your point of view—taken as theoretical possibility—is incontestable. For me, however, the expectation that the adequate formulation of the universal laws involves the use of *all* conceptual elements which are necessary for a complete description, is more natural.<sup>45</sup>

Bohr, however, attacks also this last defense line:

Even if such an attitude might seem well-balanced in itself, it nevertheless implies a rejection of the argumentation exposed in the preceding, aiming to show that, in quantum mechanics, we are not dealing with an arbitrary renunciation of a more detailed analysis of atomic phenomena, but with a recognition that such an analysis is *in principle* excluded.<sup>46</sup>

As for the second inadequacy for which Einstein blames quantum theory—namely, that it contradicts the “well-founded requirement that in the case of a macro-system, the motion of the system should approach the motion following from classical mechanics”—the author finds an unexpected opponent in D. Bohm, a physicist who, like himself, believes in a deterministic interpretation of nature. Bohm<sup>47</sup> maintains that Einstein’s requirement is not based on experimental evidence at all. To prove his assertion, he discusses two cases, ideally possible also in macroscopic physics, dealing with light and mechanics. Then he concludes by completely rejecting Einstein’s demand as leading to the same subjectivism for which Einstein blames the “orthodox” theory.<sup>48</sup>

There are other discussions at present among leading physicists, centered on the interpretation of quantum mechanics.

Schrödinger<sup>49</sup> came up recently with a theory of his own about the interpretation of waves in quantum physics. In summary his ideas are the following. The only reality of the physical world are waves. There are no particles and there are no energy quanta; both are an illusion due to a wrong interpretation of resonance phenomena of interfering waves. Moreover, any attempt to describe the physical phenomena in terms of particles without contradicting the well-established wave character of their propagation in space leads to impossible, unaccept-

able conceptions. All difficulties, on the contrary, disappear if one abandons the particle concept and uses only the idea of wave.

As a decisive answer to such criticisms, Born,<sup>50</sup> avoiding all mathematical questions, simply pointed out the evident demand of common sense. If the theoretical physicist wants to connect his results with experimental facts, he must after all describe them in terms of bodies, not of waves. For the world consists of tangible bodies, not of waves. And the laws governing the motion of ordinary bodies are undoubtedly those of Newtonian mechanics, which are concerned only with particles, not waves. To this end it is obviously necessary that the corpuscle concept, as part of matter in bulk, be preserved.

Another problem concerns the possibility of a deterministic interpretation of the behavior of single microsystems. D. Bohm suggested recently a new "interpretation of the quantum theory in terms of

<sup>50</sup>"The Interpretation of Quantum Mechanics," *British Journal for the Philosophy of Science*, iv (1953), 95 ff.

<sup>51</sup>"A Suggested Interpretation of the Quantum Theory in Terms of Hidden Variables," *Physical Review*, LXXXV (1952), 166 ff.; "Proof that Probability Density Approaches  $|\psi|^2$  in Causal Interpretation of the Quantum Theory," *Physical Review*, LXXXIX (1953), 458 ff.

<sup>52</sup>Although any final evaluation of Bohm's theory is premature it may be useful to notice its similarity with De Broglie's theory of the pilot-wave. In this connection J.-P. Vigiér pertinently writes about the "causal theory": "Sous cette forme la théorie présentée au Congrès Solvays par M. L. de Broglie ne survécût pas aux objections soulevées par M. Pauli, objections dont certaines du reste ont été surmontées ensuite par M. D. Bohm. Elle présente toutefois des difficultés dont on n'entrevoit pas la solution: difficultés classiques d'abord relatives au lien entre champ et particules, difficultés propres ensuite relatives à la nature du champ quantique" ("Physique relativiste et physique quantique," *La Physique quantique restera-t-elle indéterministe?* p. 101).

<sup>53</sup>The theory of the double solution is presented by the author in *La Physique quantique restera-t-elle indéterministe?* and "Une interprétation nouvelle de la méca-

nique ondulatoire est-elle possible?" *Il N. Cimento, Series x*, i (1955), 37 ff.

As for the present state of the problem the author writes: "... toute démonstration précise est actuellement impossible. Ce qui malheureusement rend présentement impossible une étude précise des conséquences de la non-linéarité de la propagation des onde  $u$ , c'est que nous ne connaissons pas la forme des termes non linéaires à introduire dans les équations de propagation; nous savons seulement que ces équations doivent se réduire presque partout dans l'espace aux équations linéaires complètes de la mécanique ondulatoire usuelle. Les équations non-linéaires complètes ne pourraient, semble-t-il, être fournies que par une nouvelle théorie de la 'Relativité' 'supergénéralisée' qui ferait rentrer toutes les catégories de champs  $u$  dans la structure même de l'espace-temps" (*Il N. Cimento, Series x*, i, 48).

<sup>54</sup>"Nach meiner Meinung ist es im Prinzip nicht befriedigend, eine derartige theoretische Einstellung der Physik zugrunde zu legen . . ." ("Überlegungen zur Interpretation der Quantenmechanik," p. 40).

<sup>55</sup>"Die einzige bisherige annehmbare Interpretation der Schrödinger-Gleichung ist die von Born gegebene statistische Interpretation" (*ibid.*).

hidden variables.”<sup>51</sup> The author says that he was prodded to think out this theory by the need of finding a way out of the difficulties that the quantum theory, as it is usually interpreted, is not able to meet at the nuclear level. According to him, there is no wave-corpuscle enigma any longer, just as there is none in Maxwell’s electrodynamics. In his theory, too, the wave function of an individual particle is a representation of an objectively real field. In contrast to the usual interpretation, the new interpretation permits him to conceive of each individual system as being in a precisely definite state, whose changes with time are determined by definite laws analogous to the classical equations of motion. Quantum mechanical probabilities are considered only as a practical necessity, not as a manifestation of an inherent lack of complete determination in the properties of matter at the quantum level. Yet there are serious difficulties against the acceptance of Bohm’s theory.<sup>52</sup>

In the same line as Bohm’s “causal interpretation” is De Broglie’s theory of the double solution (where, besides the usually considered wave function—that is, the  $\psi$ -function—there is another wave function, called the  $u$ -function). The author proposed this as a revised version of his theory of the pilot-wave. However, although De Broglie expects much of his new idea and claims some good results, the situation, by his own admission, is far from satisfactory.<sup>53</sup>

To sum up, what is the conclusion issuing from the above-mentioned physicists’ discussions?

The wisest answer seems to be that of Einstein. After having examined all the existing alternatives—the theories of Bohm and De Broglie and the theory of Schrödinger—to his own dissatisfaction,<sup>54</sup> he declares:

The only acceptable interpretation of the Schrödinger equation given up to this time is the statistical interpretation offered by Born.<sup>55</sup>

Consequently there is no question of an overrating of the orthodox interpretation if from now on we mainly consider this theory. In particular we are going to examine its most characteristic expression, the principle of complementarity.

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### III. The Principle of Complementarity

Complementarity aims at being the theoretical principle—both logically coherent and perfectly consistent with experimental evidence—expressing the typical features of the physical investigation of micro-reality.

Such typical features are represented by the following two successive steps. First, in order to describe any experimental arrangement and the results of observations, the physicist must have recourse to the terminology of classical physics; that is to say, he is compelled to use the words of common language appealing to imagination, to talk, for example, in terms of corpuscles and waves. But common language has grown out of everyday experience and cannot surpass its limitations. Therefore he must use an obviously inadequate language when dealing with atomic physics, where macroscopic physics breaks down. Secondly, the physicist cannot—as a matter of principle—obtain his information, to be expressed with inadequate concepts, directly from microentities; but he must always use instruments which necessarily disturb in an uncontrollable way the state of the object investigated. In fact, to get any information at all of a microsystem, he must use a measuring instrument, at least a photon; but this disturbs the examined system through the inherently connected Compton effect. Therefore if one considers that quantum mechanics has to take into consideration the interaction between object and apparatus, one sees that there can exist no single experimental arrangement giving complete information about the state of microentities. Consequently in order to get full experimental information we must use mutually exclusive—complementary—experimental arrangements to obtain, in

<sup>56</sup>"Discussion with Einstein," pp. 209 f. In a more detailed way the same author in another article says: "... an inherent element of ambiguity is involved in assigning conventional physical attributes to atomic objects. A clear example of such an ambiguity is offered by the dilemma ... as to the properties of electrons or photons, where we are faced with the contrast revealed by the comparison between observations regarding an atomic object, obtained by means of different experimental arrangements. Such empirical

evidence exhibits a novel type of relationship, which has no analogue in classical physics and which may conveniently be termed *complementarity* in order to stress that in the contrasting phenomena we have to do with equally essential aspects of all well-defined knowledge about the objects" ("On the Notions of Causality and Complementarity," p. 52).

<sup>57</sup>"On the Notions of Causality and Complementarity," p. 54.

<sup>58</sup>"Discussion with Einstein," p. 222.

turn, complementary information on the atomic object under consideration.

The principle of complementarity only theorizes this state of affairs forced on physicists by reality itself. In the words of Bohr, the author of the principle:

. . . evidence obtained under different experimental conditions cannot be comprehended within a single picture, but must be regarded as *complementary* in the sense that only the totality of the phenomena exhausts the possible information about the objects.<sup>56</sup>

Complementarity, then, issues directly from experiments. But its signification seems to reach far beyond all experimental evidence, for it claims to be the physical explanation of the quantum riddle and all similar enigmas.

The complementary mode of description does indeed not involve any arbitrary renunciation of customary demands of explanation but, on the contrary, aims at an appropriate dialectic expression for the actual conditions of analysis and synthesis in atomic physics.<sup>57</sup>

According to the principle there is simply no riddle at all; difficulties just vanish in the face of logico-experimental considerations. Microphenomena are not visualizable, that is all. We are wrong in overemphasizing classical and imaginable concepts in a field where they are obviously inadequate; we must but keep to experiment as well as to mathematical formalism.

Actually, microphysics presents some striking instances that demonstrate how we must give up visualizing atomic phenomena. Bohr introduces an example to which Einstein also had called attention.<sup>58</sup> Let us take a photon. If a semireflecting mirror is placed in its way there are two possibilities for its direction of propagation. If we place two photographic plates, one in each of the two directions of propagation, the photon may be recorded on only one of the two plates. But let us suppose that we replace the plates by mirrors; we may observe effects exhibiting an interference between the two reflected wave trains.

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In any attempt of a pictorial representation of the behaviour of the photon we would, thus, meet with the difficulty: to be obliged to say, on the one hand, that the photon always chooses *one* of the two ways, and, on the other hand, that it behaves as if it had passed *both* ways.<sup>59</sup>

Another example of the inadequacy and contradictions due to an exaggerated application of classical imaginable concepts to quantum physics is given by Heisenberg's grating.<sup>60</sup> Let us have an alpha-particle being reflected at a diffraction grating. It seems to be an unobjectionable statement that the radium atom, by which the particle is emitted, does possess hitherto unknown properties which accurately define the direction of propagation of the particle. Yet this obvious statement confronts us with a seemingly insoluble paradox. We know with certainty that the mechanical forces of interaction between the grating and the particle vanish very rapidly as distance increases, so that the reflection is influenced only by the grating lines near the incident particle. But, on the other hand, we know for sure from wave theory that the *entire* grating—therefore also distant lines—exert influence on the particle insofar as reflection is concerned. Heisenberg cuts the Gordian knot by having recourse to complementarity considerations. When there is no experience enabling us to localize the particle before the reflection, it is meaningless to talk of its position; so it is understandable that the entire grating influences the reflection. When, on the contrary, we make a measurement to know the position of the particle, we can measure it and foresee consequently on what line the particle is going to fall; but this measurement disturbs uncontrollably the momentum and the associated wave of the particle, so that the diffraction pattern, due to reflection, is destroyed. In all such cases complementarity claims to be the only rationally acceptable physical interpretation.

Quantum scientists are sure that complementarity is able to clarify many strange features of reality, both in physics and in other fields.

<sup>59</sup>*Ibid.*

<sup>60</sup>*Die physikalischen Prinzipien der Quantentheorie*, pp. 58 f. See also *Philosophic Problems of Nuclear Science* (London: Faber & Faber, 1952), pp. 48 ff.

<sup>61</sup>"Dans son domaine d'application, le concept d'état stationnaire possède tout

autant de 'réalité' ou si l'on veut, tout aussi peu de 'réalité' que les particules élémentaires elles mêmes" (Bohr, *La Théorie atomique*, pp. 10 f.).

<sup>62</sup>*Ibid.*, p. 75.

<sup>63</sup>L. de Broglie, "Sur la complémentarité des idées d'individu et de système," *Dialectica*, II (1948), 325 ff.

In physics complementarity in regard to wave-corpuscle properties of microentities has already been considered in the preceding. Photons are both particles and waves, for we can either experience their corpuscular properties, by means of the Compton effect, or their wave-like behavior, by having them interfere in a Young interference setup. Just the same thing is true of material particles. In numberless experiments we can even count them, yet there are other facts—for example, selective reflection by metal crystals—that force us to admit also for matter some typical wave properties. In addition, there are several quantum facts, otherwise unaccountable for, that complementarity tries to throw light upon. As a typical example let us consider the relations between chemical and mechanical properties of the atom. In chemistry we consider the atom as such, as a unitary structure; but this implies that we must renounce any mechanical description of the inner details of the atom. In fact, if we want to investigate with mechanics the details of the atomic structure, we must use a measuring instrument, at best a single photon, to find out where electrons are inside the atom. But this adds such a great deal of energy to the atom that the electron under consideration at once leaves the atomic union. Consequently when we demonstrate the spatial relations of the parts of the atom, we destroy at the same time the atomic unitary structure. Complementarity takes into due consideration both the atomic and the spatial-intuitive concepts, and simply says that mechanical and chemical methods of describing minute processes are mutually exclusive; that is, mechanical and atomistic properties are complementary. In a similar way, complementarity has also been applied to the relations between stationary states of an atom and intra-atomic motion of electrons. The application of the concept of stationary state excludes the possibility of following the movement of individual electrons inside the atom, and vice versa.<sup>61</sup> Also in connection with stationary states it was pointed out that there are complementarity relations between a univocal definition of atomic energy and a description of the atom's evolution in time.<sup>62</sup> Finally, still within atomic physics, complementarity was applied to the relations between the individual components of a system and the system made up of them.<sup>63</sup>

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Outside physics, too, complementarity, though vaguely defined, seems susceptible of some applications. It is always the same methodological principle. There is no unique, clearcut image of our world of experience. We must patiently piece together several complementary perspectives, taken from different standpoints, if we are to describe one phenomenon in its fullness. There is complementarity, for instance, in the knowledge of life. The vitalist thesis that life has its "own" laws and the mechanist thesis that the physico-chemical laws apply "without further qualification" in living matter need not necessarily be contradictory.<sup>64</sup> Moreover, complementarity can be applied even to psychology.<sup>65</sup>

As a conclusion from all the preceding considerations we may say that the principle of complementarity has a twofold meaning, one negative and one positive. As a negative result, complementarity points out the intrinsic inadequacy, when applied to microphysics, of the classical concept of an observation that does not disturb reality observed, since complementary aspects are due to the interaction of

<sup>64</sup>Of course, physicists do not positively suggest any solution but only envisage the negative side of the question. "... il faut observer que l'étude des phénomènes vitaux ne nous entraîne pas seulement dans le domaine de la théorie atomique où nous fait défaut l'idéalisation habituelle d'une distinction nette entre phénomène et observation; mais en outre, l'analyse de ces phénomènes au moyen des concepts physiques est soumise à une autre limite essentielle, provenant de ce que, si l'on veut pousser l'observation d'un organisme aussi loin que possible au point de vue de la théorie atomique, il faut pratiquer sur lui une intervention qui le tue. En d'autres termes: *l'application stricte des concepts adaptés à la description des phénomènes de la Nature inanimée exclut toute utilisation des lois des phénomènes vitaux*" (Bohr, *La Théorie atomique*, p. 19).

<sup>65</sup>Bohr, *ibid.*, p. 91. Pauli, "Die philosophische Bedeutung der Idee der Komplementarität," *Experientia*, vi (1950), 74 f.

<sup>66</sup>"L'essentiel dans tout cela, c'est que les résultats des mesures constituant les

connaissances du savant ne décriront pas l'univers physique tel qu'il est, mais tel qu'il est connu par le savant à la suite d'expériences comportant des perturbations inconnues et incontrôlables... (La physique) n'est plus la contemplation passive d'un univers figé: elle devient une lutte corps à corps où le savant parvient à arracher au monde physique qu'il voudrait connaître quelques renseignements toujours partiels, lui permettant de faire des prévisions incomplètes et, en général, seulement *probables*" (L. de Broglie, *Physique et microphysique* [Paris: Albin Michel, 1947], pp. 149 f.).

From this state of affairs it follows that the definition of physical phenomenon is to be changed. It is no longer a physical event as it happens independently of the observer: *phenomenon* refers now "to the observations obtained under specified circumstances, including an account of the whole experimental arrangement" (Bohr, "Discussion with Einstein," p. 237).

As a consequence scientists sometimes speak—in a most unfortunate way—of no objectivity of physical knowledge in quantum theory.

the object with instruments. Observation in the atomic realm is possible only at the expense of absolute observability.<sup>66</sup> As for the positive side, however, complementarity's merits are less clearly recognizable. But it is necessary to admit that, at least confusedly, the principle validly contributed to reveal a most important fact, that the physical world is far more complex than classical theory had thought it. Light and matter, most obvious physical things, appear now to us less inadequately in their somewhat mysterious nature.

#### IV. Complementarity Implications

Complementarity, if the physical theory is accepted in its full meaning, may bring about a change in outlook in the philosophic conception of the material world.

Actually complementarity teaches us that perceptibility of the world picture is by no means an unconditioned demand for science. What we know about atoms has necessarily a space-time framework, for it comes from experiments, which must be carried out in space and time. But the fact that features we are informed on have contradictory aspects signifies that we are not entitled to naively attribute to the atom as its properties the results of our quantitative measurements. The experiment, in fact, is a violation of nature, which must react to our imposition, and we state in formulae the laws of such reactions. But every such statement is valid only in relation to the experiment through which it was obtained and cannot be generalized to a hypothetical undisturbed state of microentities.

An atomic 'particle' is a physical reality which lies beyond the limits of immediate perception, and which we can no longer make accessible to perception by describing it in our spatial and temporal concepts. It is therefore, strictly speaking, neither a particle nor a wave. But in order to acquire any knowledge of it at all, we must bring it into contact with some sort of measuring apparatus; in the simplest case with a microscope or a diffraction grating. The reaction of the measuring apparatus to the atomic configuration we are then driven to interpret in our perceptual concepts: 'a particle was seen here and here' or 'a wave of this

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and this length was diffracted'. The concepts 'particle' and 'wave' or, more exactly, 'spatially discontinuous event' appear therefore as interpretations demanded by the forms of our perception for processes that are no longer immediately perceptible.<sup>67</sup>

Are we, then, entitled to draw the conclusion that mechanism is doomed? The theory seems to point strongly to that direction. For mechanism considered the world as an association of observable objects moving about according to precisely knowable laws, so that one

<sup>67</sup>C. F. v. Weizsäcker, *The World View of Physics* (Univ. of Chicago Press, 1952), p. 45.

<sup>68</sup>P. A. M. Dirac, *The Principles of Quantum Mechanics* (Oxford: Clarendon Press, 1947), p. vii.

<sup>69</sup>L. de Broglie, *Eléments de théorie des quanta et de mécanique ondulatoire* (Paris: Gauthier-Villars, 1953), pp. 219 f.

<sup>70</sup>P. Jordan, *Die Physik des 20. Jahrhunderts* (Braunschweig: Vieweg, 1936), pp. 112 f.

<sup>71</sup>"The concept of the atom in itself has only the negative significance of showing us what sort of concepts we ought not to introduce into physics. Not even objective physical existence—that is, the capacity of having physically definable predicates, even if we do not know them—can be attributed to the 'atom in itself'" (Weizsäcker, *World View of Physics*, p. 122).

<sup>72</sup>"Je ne puis m'empêcher de croire que le cadre de la relativité généralisée . . . suffit pour rendre compte des phénomènes (quantiques). Conformément au rêve de Descartes, qui vouait la physique théorique à l'étude géométrique de la matière en mouvement, il réduit la nature à une substance unique, matérielle, descriptible géométriquement, dont les formes successives, en perpétuelle transformation, rendent compte de la prodigieuse diversité des phénomènes élémentaires" (Vigier, "Physique relativiste et physique quantique," p. 111).

<sup>73</sup>"Le postulat quantique . . . exprime que toute observation des phénomènes atomiques entraîne une interaction finie avec l'instrument d'observation; on ne

peut par conséquent attribuer ni aux phénomènes ni à l'instrument d'observation une réalité physique autonome au sens ordinaire du mot" (Bohr, *La Théorie atomique*, p. 50).

<sup>74</sup>*Ibid.*, p. 74.

<sup>75</sup>*Ibid.*

<sup>76</sup>Pauli, *Experientia*, vi (1950), 74.

<sup>77</sup>L. de Broglie, *Physique et microphysique*, pp. 143 f.

<sup>78</sup>Let us hint at just one aspect of the epistemological problem. While atomic physics seems to have outgrown the Cartesian ideal of clear and distinct ideas taken from the world of intuition, it must evidently always have recourse to such concepts—as they are the only possible ones. These concepts in atomic physics, however, cannot be used in an intuitive way but must be taken in a figurative sense. The similarity of the word-content of physicists and philosophers about this problem is remarkable.

Philosophers talk of analogy—*similitudo quaedam dissimilis*. "Ondes et corpuscules univoquement conçus sont inconciliables, mais l'analogie nous permet de nuancer les notions, de telle sorte que nous puissions les concilier. Ainsi, par l'introduction du concept analogue, nous pouvons donner un sens plein à la Complémentarité de la mécanique ondulatoire. . . . Mais si les notions sont prises en sens univoque, il n'y a pas lieu pour des ajustements; l'onde et le corpuscule sont simplement juxtaposés et ne peuvent être reliés entre eux que par des relations de probabilité. Pour employer les deux notions dans une certaine mesure, même simultanément, il faut renoncer à leur caractère univoque. Parler

could form a clear picture in space and time of the whole scheme. Now complementarity has demonstrated that there are events in the physical world which cannot be represented against the background of space and time. So we come to the conclusion that the fundamental laws of nature "do not govern the world as it appears in our mental picture in any very direct way, but instead they control a substratum of which we cannot form a mental picture without introducing irrelevancies."<sup>68</sup>

Yet the very successes of complementarity present new and difficult problems both in the epistemological and ontological field. What is, in fact, the meaning of statements like the following: "A physical magnitude before the experiment has only possible values,"<sup>69</sup> "It is the experiment that forces the electron within the atom to take a sharply defined position,"<sup>70</sup> "We cannot know the atom in itself"?<sup>71</sup>

Quantum theory, whose complementarity is the highest conquest, seems unable to give an adequate answer. Even worse, it seems also unable to solve the dispute between mechanistic<sup>72</sup> and positivistic<sup>73</sup> interpretations of those philosophic problems. Nor is such a situation difficult to understand. Any physical theory, indeed, finds it very hard to avoid both extremes, since it must be positive without being positivistic and must apply mathematics to the description of reality without being mechanistic.

Complementarity reveals itself equally inadequate as regards the ontological value of complementary aspects. The theory says that quantum mechanics solutions have an intuitive meaning only insofar as the particles can be considered free.<sup>74</sup> But it gives no precise answer to the ontological question. Both "wave" and "corpuscle" are abstractions;<sup>75</sup> the concepts have obviously symbolic character;<sup>76</sup> they are two opposite idealizations.<sup>77</sup> Complementarity, therefore, can be viewed as an adequate interpretation of facts only on the positivo-experimental level. As for the philosophic level, its contribution is invaluable, but mostly negative; it informs philosophers on what micro-reality certainly is not. For a complete interpretation of the material world the principle obviously needs the help of philosophy. Complementarity, then, may be an instance for stressing the need and possibility<sup>78</sup> of co-operation between atomic physics and philosophy.

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des aspects corpusculaires au lieu des corpuscules c'est déjà analoguer la notion de corpuscule" (F. Selvaggi, S.J., "Le rôle de l'analogie dans les théories physiques," *Proceedings of the XIth International Congress of Philosophy* [Louvain: Nauwelaerts, 1953], VI, 142 f.) See also W. Büchel, S.J., "Zur Naturphilosophischerkenntnistheoretischen Problematik der Quantenphysik," *Scholastik*, xxviii (1953), 183 f. and, by the same author, "Die Diskussion um die Interpretation der Quantenphysik," *Scholastik* xxix (1954), 242 f.

Now, analogy's typical features, except the name, are to be found also in physicists' writings. Dealing with uncertainty relations, Bohr explicitly remarks: ". . . it is important to recognize that no unambiguous interpretation of such relations can be given in words suited to describe a situation in which physical attributes are objectified in a classical way" ("On the Notions of Causality and Complementarity,"

p. 52). It is evidently analogy that is meant by Born when the author speaks of the scientific procedure of "adapting" or "generalizing" a concept when it "in its original meaning turns out to be too narrow." After having discussed the concept of number (from natural to algebraic, transcendental, complex) as an example of logical and fruitful generalization of an idea, he concludes about atomic particles: "I maintain that the use of the concept of particle has to be justified in the same way. It must satisfy two conditions: First it must share some (not in the least all) properties of the primitive idea of particle (to be part of matter in bulk, of which it can be regarded as composed), and secondly this primitive idea must be a special, or better, limiting case. Now it is exactly in this sense that the particle concept is used in quantum mechanics" ("The Interpretation of Quantum Mechanics," p. 101).

### Problems in the Teaching of Contemporary Philosophy

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#### I. The Field of Modern Philosophy

It is generally agreed that the term "modern philosophy" embraces at least the following men: Descartes, Leibniz, Spinoza, Locke, Berkeley, Hume, Kant, Fichte, Schelling, Hegel, Comte, J. S. Mill, Schopenhauer, and perhaps also Nietzsche and Bergson. Individual historians of modern philosophy might each add a few names to this list; but there would be no general agreement about the additions, whereas there would be general agreement that none of these should be omitted. These thirteen, or fifteen, are the principal names on any list.

Not only is there general agreement about who the men are who are denoted by the term "modern philosophers," but there is also general agreement about the schematization which most effectively organizes these philosophers into an intellectually assimilable field of study. So it is customary to group the first three as rationalists; the second three as empiricists; to designate Kant as a critical philosopher who attempted to synthesize rationalism and empiricism; to group Fichte, Schelling, and Hegel as idealists, who represent that residue from the break-up of the Kantian synthesis, which leans in the direction of the earlier rationalism; to group Comte and J. S. Mill as positivists who represent the other residue from the break-up of the Kantian synthesis, which leans in the direction of the earlier empiricism; to group Schopenhauer and—if they are included in modern philosophy—Nietzsche and Bergson as philosophers of life who attempt to synthesize idealism and positivism.

To be sure, any schematization in the pure or social sciences, in the humanities, or in philosophy suffers from serious limitations and must not be taken with ultimate seriousness. But despite its limited validity, such a scheme does enable the student to see the forest as well as the trees, so that as a pedagogical hypothesis it does much good and little harm.

In the field of modern philosophy, then, one observes three significant points of agreement: (1) who the men are who are denoted by the term "modern philosophers"; (2) what the schematization is which enables the

student to relate these men; (3) what the order of presentation should be—rationalists, empiricists, Kant, idealists, positivists, vitalists.

## II. The Problems of Contemporary Philosophy

There are no such general agreements regarding the field of contemporary philosophy. Just which men are denoted by the term "contemporary philosophers," what the schematization is which best manifests the relationships between these unidentified men, in what sequence they should be studied—none of these points is a matter of general agreement. Even more remarkable is the lack of agreement on what the phrase "contemporary philosophy" means. For until that is clear there can be no agreement on the men denoted by the term, or on the scheme showing their relationships.

## III. First Problem: The Meaning of "Contemporary Philosophy"

It would seem possible to interpret the word "contemporary" very literally and to decide that a "contemporary philosopher" is any philosopher alive at the moment the term is used. But such a literal definition suffers from at least two disadvantages. First, it omits from the rank of philosophers certain very important figures not denoted by the term "modern philosophers" and yet not alive today—such men as Dewey, Whitehead, Husserl, Schlick. Second, any list of contemporary philosophers would be revisable from moment to moment depending upon the contingency of death.

To avoid these inconveniences one might define a contemporary philosopher as a twentieth-century philosopher. But this definition also has two disadvantages.

First, it would rule out of philosophy certain very important figures who are not included among the modern philosophers and who did not live in the twentieth century—Kierkegaard and Marx, for example. The second disadvantage is much deeper. That disadvantage is this: it is unphilosophical to divide periods of philosophy according to time—for example, the twentieth century. Two different periods of philosophy must differ *philosophically*; otherwise there are not two. So medieval philosophy differed from ancient philosophy *in the philosophical questions it raised* and not merely in time. Similarly, modern philosophy differed from medieval *in the questions it raised* and not merely in time. So, if the philosophy of our time merely prolongs into the twentieth century the philosophical problems entertained from Descartes to Schopenhauer or Bergson, then *there is no such thing as contemporary philosophy* in any philosophical sense; there is only the contemporary phase of modern philosophy. On the other hand, if the

philosophers of our time are raising genuinely new philosophical problems, if they are asking, not the questions posed by modern philosophers, but new questions of their own, then *there is such a thing as contemporary philosophy*; but it is as different from modern as modern is from medieval, and as medieval is from ancient.

Involved in the question, "What does 'contemporary philosophy' mean?" is this other question, "Has modern philosophy come to an end, and if so, have we entered upon a genuinely new period in philosophy?" Unless the answer to both parts of the second question is yes, the first question is itself devoid of philosophical meaning.

I suggest that the answer to both parts of the second question is yes. Modern philosophy has come to an end because its characteristic problems (the epistemological problem, the mind-body problem, the idealism-realism problem, the problem of God, the space-time-matter problem, the problem of causality) no longer agitate the minds of philosophers. So, for example, the problem of God is obviated by opting for postulatory theism, as in Kierkegaard, or for postulatory atheism, as in Nietzsche.

But a genuinely new era has begun in philosophy because new problems are being debated. The problems preoccupying the philosophers of this time fall largely into two areas: (1) problems associated with philosophic method and meaning; (2) problems associated with the "new man."

The related problems of method and of meaning (pragmatism, phenomenology, and analysis) are not problems about the method of communicating already achieved philosophical truth (*via iudicii*); the Aristotelian logic solved that problem by providing an organon, a rhetoric, for the communication of philosophy. The methodological problem of our time is concerned with the method of discovering philosophical truth (*via inventionis*). Philosophy is learning, rather late in the day, to scrutinize its own questions, to explore the twin problems of sources and procedures for arriving at answers, to become decently self-conscious.

The problem of the "new man" (Marxism and existentialism) is the problem, not of meaning in general, but of the meaning of man; of how the individual person shall transcend the limitations of his individuality, his society, and even of his finitude; of how he shall emerge into some kind of pure autonomy, pure freedom, transcendence.

If the convictions that modern philosophy has ended and that contemporary philosophy has begun are valid, then it is possible to determine by a philosophical test whether a given philosopher is modern or contemporary—the simple test of which set of questions he asks. So, for example, Marx, Kierkegaard, and Nietzsche are contemporary philosophers because they are preoccupied with the contemporary problem of the "new

man." On the other hand, Brand Blanshard is a modern philosopher because he is concerned with the modern problem of idealism. More difficult to classify are Santayana, Bergson, and Whitehead; perhaps the safest course is to refuse to be categorical about them and to consider them as transitional figures.

Contemporary philosophy, then, turns out to mean those philosophies which are concerned primarily with the problems of method and the problems of the "new man." It may be very sensibly objected that neither of these problems is specifically contemporary, since they are found not only in contemporary philosophy but also in modern, medieval, and even ancient philosophy. Take the problems of method and meaning, for example. Surely those problems agitated moderns like Descartes and Locke; surely they concerned at least the late medieval logicians—indeed, it may be possible to trace contemporary logical analysis itself to medieval logic; surely method was one of the lifelong preoccupations not only of Aristotle but also of Socrates and Plato. Similarly the problems of the "new man" can be traced through modern and medieval philosophy back to Socrates (Kierkegaard himself saw this affinity) and Plato (the *Republic* is precisely a study of the "new man," socially and individually). Stoicism was a concurrent effort to delineate the "new man."

There is a sense in which there are no new questions in philosophy—the pre-Socratics raised them all. And in that sense, there are no historical periods in philosophy; there is only the continuing philosophic enterprise. But there *are* new emphases and new ways of conceiving the old questions; and from *that* point of view there *are* historical periods in philosophy. So to the modern, medieval, and ancient philosophers, the problems of method and of meaning were prolegomena to the establishment of systematic conclusions; but to the contemporary methodologist they are the only valid philosophic problems. What is new about contemporary methodological philosophies is the purity with which they raise their problems, the determination to treat these problems for their own sake and not as necessary preliminaries, and the refusal to admit into philosophy any datum other than what is immediately given in the problem of method itself. In that sense, the methodological philosophies are dealing with a new problem.

The contemporary "new-man" philosophy, whether Marxian or existentialist, similarly differs from any earlier "new-man" philosophy. Not only does it restrict philosophy to the study of man (existentialism) or at least subordinate all other problems to the man's social needs (Marxism), but it has to it a new quality of anthropocentricity—it is concerned with the post-Christian man, with the man who has known and rejected either Christianity, or, at the very least, Christendom. By and large, the "new-man"

philosophy in either its Marxian or its existentialist phase seeks to make a man who is the summit of being (that would not be altogether new), *after twenty centuries of knowing that he is not the summit of being*—and that is new. It is a new kind of “new man” that contemporary “new-man” philosophy seeks—a new man who believes in his own power to overcome his own finitude. Christianity had promised a genuinely new man, and the “new-man” philosophy has secularized that promise; hence its peculiar *depth*. The genuine and altogether supernatural transformation of man which Christianity effects through its liturgy; the death with Christ to sin and nature; the gloriously victorious resurrection with Christ to the new supernatural life, begun through baptism and achieved through the Eucharist; and the eschatological expectation of the final kingdom of Christ in which we, as members of what St. Augustine calls the “integral Christ,” shall reign with Him in a new heaven and a new earth—it is precisely this genuine, this objective, this even-now-being-realized promise on which the “new-man” philosophy feeds. It is no dream but a memory of a real possibility that fires the “new-man” philosophy. The “new-man” philosophy is new precisely because it is neither pre-Christian, like Plato’s and Socrates’s, nor extra-Christian, like that of the Renaissance and modern philosophy; it is the Christian expectation itself, secularized.

I think that, in the senses indicated, it can be said that contemporary philosophy is raising new questions—the problems of method and the problems of the “new man”; and it is to be anticipated that, however audacious some or all of these questions may be, however open to religious criticism the intellectual climate in which they can arise, still, once asked they must be answered; and the answers will contain, at least incidentally, new and precious philosophical insights which not even the believer may overlook.

#### IV. Second Problem: Who Are the Contemporary Philosophers?

The weeding out which history so dispassionately accomplishes has reduced the number of major modern philosophies to about fifteen. That process has yet to be applied to contemporary philosophy. It is therefore antecedently probable that any tentative list of contemporary philosophers must be somewhat longer than fifteen—long enough to omit no major figure, short enough to be restricted to men of international reputation.

One possible list of contemporary philosophers, understood in the sense defined, would be this: Bergson, Carnap, Dewey, Heidegger, Husserl, James, Jaspers, Kierkegaard, Marcel, Maritain, Marx, G. E. Moore,

Nietzsche, Peirce, Reichenbach, Russell, Santayana, Sartre, Schlick, Whitehead, and Wittgenstein.

## V. Third Problem: Schematization

It would be as unphilosophical to ignore affinities as it would be to force them. It is evident, for example, that Peirce, James, and Dewey should be grouped together as pragmatists and that Kierkegaard, Nietzsche, Heidegger, Sartre, Jaspers, and Marcel should be grouped together as existentialists—provided that such groupings are understood not to deny significant differences.

Similarly, Moore and Russell might be grouped as logical analysts; Schlick, Carnap, and Wittgenstein as logical positivists; Reichenbach might be considered a representative of scientific empiricism. Moreover, the last two groups (logical positivists and scientific empiricists) are often grouped as logical empiricists; and all three (logical analysts, logical positivists, and scientific empiricists) might be grouped as analytic philosophers or philosophic analysts.

Husserl is a representative of phenomenology; Marx of Marxism; Maritain of Thomism. Santayana, Bergson, and Whitehead, as already indicated, are conveniently treated as transitional philosophers.

From the twenty-one contemporary philosophers listed above, there would appear to emerge seven groupings: the transitionalists (Santayana, Bergson, Whitehead), the pragmatists (Peirce, James, Dewey), the phenomenologists (Husserl), the analysts (Moore, Russell, Schlick, Carnap, Wittgenstein, Reichenbach), the Marxists (Marx and, possibly, Stalin), the existentialists (Kierkegaard, Nietzsche, Heidegger, Jaspers, Sartre, Marcel), and the Thomists (Maritain).

But significant relations appear to exist not only between the individual philosophers included in one grouping but also between some of the groupings themselves. So the analysts and the pragmatists are both concerned primarily with the problem of method; indeed, it would not seem too much to say that Peirce anticipated many of the positions of the analysts. But this term "methodologists" or "methodological philosophers" would embrace not only the pragmatists and the analysts but also the phenomenologists; for Husserl was convinced, at least in his earlier years, that his method prescinded from any given metaphysical position and was purely a method.

Let us, then, use this term "methodologists" to connote philosophers whose chief, if not only, concern is with the method of philosophy; philosophers who judge that any philosophical conclusion is incidental to the method employed and, therefore, tentative and revisible in the light of

improvements in method; philosophers who like to ask "What do you mean?" and who expect an answer in terms of data, phenomena, more or less immediately given in human experience; philosophers who are problem-centered rather than system-centered and who are suspicious of "systems" and "world views"; philosophers who are simply uncomfortable in the face of massive philosophical structures such as Thomism because they cannot exorcise from their minds the suspicion of meaninglessness. Let us, further, use the term "methodologists" to denote analysts, pragmatists, and phenomenologists.

It is tempting to group the four remaining types of contemporary philosophy (transitionalists, Marxists, existentialists, Thomists) simply as "systematists," as opposed to methodologists. By this term one would connote philosophers to whom content, conclusions, and not method were of primary importance; philosophers who have a teaching, who approximate to a world view (transitionalists, Marxists, Thomists) or, at least, like Socrates, to a view of man (existentialists); philosophers who are persuaded that reality is, in some sense, one, so that there can be a coherent explanation of it in its totality.

The categorizing of these four as "systematic" is not only tempting; it is also approximately true. Yet it will not serve as a division of contemporary philosophy, since there is nothing specifically contemporary about the notion of system in philosophy. It is necessary, rather, to locate what makes these systems contemporary, to search out, and to name the problems that give rise to these systems.

Let us leave aside the transitionalists as being not so much contemporary philosophers as bridges between the modern and the contemporary. Let us also postpone Thomism to a later section. We are left, then, with Marxism and existentialism; and our problem is whether as between these two there is any common philosophic preoccupation which would justify our grouping them together, as analysis and pragmatism may be grouped as methodologies.

Categories such as "humanism," "naturalism," "secularism," "atheism," should be avoided. In the first place, there is nothing specifically contemporary about these "isms." In the second place, these "isms" could be predicated of some or all of the contemporary methodological philosophies as significantly as they can of Marxism and existentialism. Finally, and most importantly, some, if not all of these terms, are used so elastically as to be more serviceable for rhetoric than for philosophy.

What existentialism and Marxism have in common and what characterizes them as *contemporary* systems of philosophy is their preoccupation with the second problem mentioned above—the problem of making the new man;

the problem of transcending self and society, of achieving autonomy, freedom; the problem of salvation, whether supernatural (Kierkegaard and Marcel) or natural (Nietzsche, Heidegger, Jaspers, Sartre, the Marxists). I do not, for a moment, deny the significant differences between the Marxists and the existentialists or, for that matter, among the existentialists themselves. I say only that both desire to unmake one man (the man of Christendom; the bourgeois, industrialist-capitalist man; the outward, selfish man) and to make a new man, either the man who achieves autonomy by identification of self with the laws of dialecticism and materialism in nature, man, society, and history (Marxism) or the man who achieves autonomy through inwardness, through experiencing the farthest limits of his creaturehood and therein discovers either a way of transcendence or a courage to live with the need for a transcendence which is unachievable (existentialism). If it makes sense to include both pragmatism and analysis under the category of "methodological philosophy," then equally it makes sense to include both Marxism and existentialism under the category of the "new-man" philosophy or some less cumbersome equivalent.

It remains, then, that the seven groupings of contemporary philosophers (transitionalists, pragmatists, phenomenologists, analysts, Marxists, existentialists, and Thomists) are actually reducible to four (transitionalists, methodologists, "new-man" philosophers, and Thomists).

## VI. Fourth Problem: Sequence

It seems clear that, if the transitionalists really are transitional, then any course in contemporary philosophy will begin with them. It seems equally clear that any such course conducted by a Thomist will conclude with contemporary Thomism.

What is not clear is two further points: (1) whether the methodological philosophy should precede or follow the "new-man" philosophy; (2) within each of the two last-named categories, what sequence is to be followed? Within methodological philosophy what is the proper sequence as between pragmatism, phenomenology, and analysis? And within "new-man" philosophy, should Marxism precede or follow existentialism?

The problem here is the explication of a *principle* on the basis of which to determine sequence. If chronology is the proper principle, then the "new-man" philosophy should precede the methodological, since both Marx and Kierkegaard were born before any of the methodologists. Moreover, existentialism should, on this principle, precede Marxism, since Kierkegaard (1813) was born several years before Marx (1818). On the same principle, pragmatism should precede phenomenology (Peirce, 1839; Husserl, 1859),

and phenomenology should precode analysis (Russell, 1872). But if chronology is not the right principle, then one faces the task of elaborating and justifying some other principle. For my own part, I have not yet succeeded in doing this.

So far, then, the arrangement of a course in contemporary philosophy would appear to be as follows:

A. *Transitional*: Bergson (1859), Whitehead (1861), Santayana (1863).

B. *"New-Man" Philosophy*:

1. *Existentialism*: Kierkegaard (1813), Nietzsche (1844), Marcel (1877), Jaspers (1883), Heidegger (1889), Sartre (1905).

2. *Marxism*: Marx (1818) and, possibly, Stalin.

C. *Methodological Philosophy*:

1. *Pragmatism*: Peirce (1839), James (1842), Dewey (1859).

2. *Phenomenology*: Husserl (1859).

3. *Analysis*: Russell (1872), Moore (1873), Schlick (1882), Wittgenstein (1889), Carnap (1891), Reichenbach (1891).

D. *Thomism*: Maritain (1882).

## VII. The Problem of Thomism

If contemporary philosophy is defined in terms of two areas of problems (methodology and the "new man") and if Thomists do not discuss these problems at all, then Thomism is no part of contemporary philosophy; it is, rather, the contemporary phase of a medieval philosophy. On the other hand, if Thomists, or some significant segment of Thomists, do seriously entertain contemporary problems, then, despite its medieval roots, Thomism is a contemporary philosophy.

Before addressing myself to any answer to our present question—"Is Thomism a contemporary philosophy? that is, do some Thomists evidence preoccupation with specifically contemporary philosophic problems?"—I should indicate three preliminary reservations.

First, the adjective "contemporary" used to describe a philosophy is not necessarily honorific; and the adjective "noncontemporary" is not necessarily pejorative. The great question about any philosophy is not whether it is contemporary but rather whether it is true; that is, are its problems valid (whether contemporary or not), and are its solutions to those problems demonstrably true? So, much of Platonism and much of Aristotelianism is *true*, though little, if any, of either is contemporary.

I should therefore, for my own part, care very little whether Thomism were contemporary or not. It is true, and one treasures it for that reason, as one also treasures Platonism and Aristotelianism. And to the degree that

any philosophy is true, it is also relevant to one's own intellectual life, however unrelated it may be to the problems principally agitating the minds of contemporary philosophers.

On the other hand, if it should turn out that Thomism is a contemporary philosophy, I should regard that fact as promising, for I should anticipate that the Thomist and the non-Thomist branches of contemporary philosophy might strengthen each other reciprocally.

One therefore raises this question about the contemporaneity of Thomism with intellectual interest but with detachment too. For the Thomist, nothing crucial is at stake in either possible answer to the question.

As to my second preliminary reservation, I should like to avoid any clever rhetoric about the "perennial" character of Thomism, which would purport to show that Thomism is necessarily contemporary because "perennial." I do not, for a moment, disparage the notion of a perennial philosophy or the judgment that Thomism is that philosophy. I would merely point out that the notion of a perennial philosophy is still problematic and that it might be prudent to avoid use of it until that problematic is worked out in greater detail—a project brilliantly begun by Professor James Collins.<sup>1</sup>

Thirdly, I should like to avoid, too, phrasing the question about the contemporaneity of Thomism in too sweeping a way. It is evident, I think, that many living Thomists are not contemporary philosophers; that is, many of them have no interest in contemporary philosophical problems, a state of affairs which I find, for my own part, perfectly proper. It would be an enormous loss if we all became contemporary philosophers so that there were left no living Platonists, no living Aristotelians, no living Augustinians, no living Thomists. Hence my question is not whether *all* living Thomists are contemporary philosophers but whether *some* are. If I may use a dis-

<sup>1</sup>James Collins, "The Problem of a *Philosophia Perennis*," *Thought*, xxviii (winter 1953-54), 571-97.

<sup>2</sup>"Developmental Thomism," *Thomist*, xix (Jan., 1956), 1-21.

<sup>3</sup>Trans. Galantière. New York: Pantheon Books, 1948.

<sup>4</sup>New York: Sheed and Ward, 1940. See especially pp. 1-61.

<sup>5</sup>Trans. Adamson. New York: Chas. Scribner's Sons, 1938.

<sup>6</sup>Chicago: Univ. of Chicago Press, 1951.

<sup>7</sup>Ed. Evans and Ward. New York: Chas. Scribner's Sons, 1955.

<sup>8</sup>Pp. 121-226. New York: Chas. Scribner's Sons, 1953.

<sup>9</sup>Trans. Wall and Adamson. New York: Chas. Scribner's Sons, 1938.

<sup>10</sup>Trans. Wall. New York: Chas. Scribner's Sons, 1940.

<sup>11</sup>Pp. 3-117.

<sup>12</sup>*The Existentialists* (Chicago: Henry Regnery Co., 1952); *The Mind of Kierkegaard* (Chicago: Henry Regnery Co., 1953).

<sup>13</sup>Trans. Trask. New York: Henry Holt & Co., 1947.

<sup>14</sup>Chicago: Univ. of Chicago Press, 1951.

<sup>15</sup>*Communism and Christianity* (Baltimore: Penguin Books, 1956).

<sup>16</sup>*The Mind and Heart of Love* (New York: Henry Holt & Co., 1947).

inction which I have tried to explicate in an article elsewhere,<sup>2</sup> I would phrase the question this way: Granted that conservative Thomists are not contemporary philosophers, what of developmental Thomists? Are they or are they not contemporary philosophers?

I think that they are. For they have entertained the problems which define contemporary philosophy, either directly by themselves reflecting on those problems or indirectly by their reflections on the contemporary philosophies.

In this respect Maritain occupies a unique position, for he has dealt with all of the problems of contemporary philosophy both directly and indirectly. The problem of the "new man" in its personal or existential dimension occupied him in *Existence and the Existent*<sup>3</sup> and even before that in a scattered way in *A Preface to Metaphysics*.<sup>4</sup> The same problem in its social or Marxian dimension is the theme of his numerous studies in the philosophy of culture and in his social and political writings, all of the works clustered around *True Humanism*<sup>5</sup> and *Man and the State*<sup>6</sup> and anthologized in *The Social and Political Philosophy of Jacques Maritain*.<sup>7</sup> Relevant also to the social dimension of the "new-man" problem is the second part of *The Range of Reason*<sup>8</sup> and numerous short essays in various books and periodicals.

The problems of method and of meaning are one of the recurrent themes in *The Degrees of Knowledge*<sup>9</sup> and the works clustered around it; for example, *Science and Wisdom*<sup>10</sup> and the first part of *The Range of Reason*.<sup>11</sup> In these, and in various shorter essays, he has explicitly dealt with the problems occupying pragmatism, logical positivism, and methodology generally.

But Maritain is by no means alone. The work of James Collins on the problems raised by existentialism<sup>12</sup> is, superficially, a historical and therefore an indirect approach of a Thomist to contemporary thought; but the terse, profound, and balanced evaluation is itself a direct handling of the problems raised. Yves Simon has brought a deep and a strangely fresh Thomism to the problems which engage Marxists, especially in the final chapter of his *Community of the Free*<sup>13</sup> and in the final chapter of his *The Philosophy of Democratic Government*.<sup>14</sup> Father M. C. D'Arcy has not only given his attention to the problems raised by Marxism<sup>15</sup> but also to one of the most urgent problems raised by the existentialists, the problem of love.<sup>16</sup>

Other trends among Thomists reinforce this conviction that Thomism is, in part, a contemporary philosophy. The methodological philosophies are closely allied to recent advances in mathematics and physics, and many Thomists evidence a willingness to rethink their philosophy of nature in the light of these advances. Similarly, the "new-man" philosophies are, to some degree, related to the evolutionary hypothesis in biology and the

psychoanalytic technique in psychiatry and psychology; and many Thomists are open to re-examining their philosophy of organism and of man in the light of whatever solid evidence there may be in these fields.

One may conclude, I think, that one significant group of Thomists is to be numbered among the contemporary philosophers.

### VIII. Bibliography for Beginners

Not the least of the practical problems connected with the teaching of contemporary philosophy at the undergraduate level is the problem of readings in the various philosophers. There are needed works sufficiently short to be mastered and sufficiently inexpensive to be purchased. I therefore offer here no complete bibliography of contemporary philosophy. My list is triply restricted, for I mention only books, to the exclusion of all periodical literature; only books published in English in the United States and currently available; and only three classes of such books—namely, the inexpensive paperback, the anthology, and the Thomist evaluations of contemporary philosophy with which I happen to be familiar.

#### A. Paperbacks<sup>17</sup>

##### 1. *Titles from the Twenty-one Contemporary Philosophers Listed Above*

Bergson: *Introduction to Metaphysics* (Liberal Arts Press)

*The Two Sources of Morality and Religion* (Doubleday & Co.)

Dewey: *Essays in Experimental Logic* (Dover Pubns.)

*Reconstruction in Philosophy* (New American Library of World Literature [hereafter N.A.L.W.L.] )

*Philosophy of Education* (Littlefield, Adams & Co.)

*The Child and the Curriculum* and *The School and Society* (Univ. of Chicago Press)

James: *The Will to Believe* and *Human Immortality* (Dover Pubns.)

*Pragmatism* and *Four Essays from the Meaning of Truth* (Noonday Press)

*Pragmatism: Selections* (Henry Regnery Co.)

*Essays in Pragmatism* (Hafner Pub. Co.)

Kierkegaard: *Fear and Trembling* and *Sickness unto Death* (Doubleday & Co.)

Maritain: *Creative Intuition in Art and Poetry* (Noonday Press)

<sup>17</sup>As of April 1, 1956. Significant new titles are being added regularly by various publishers. Probably the only way to keep track of what is currently available is to

subscribe to *Paperbound Books*, published three times a year by R. R. Bowker, New York.

- Marx: *Communist Manifesto* (Henry Regnery Co.)  
*The Quintessence of Dialectical Materialism* (Academic Press)
- Nietzsche: *Beyond Good and Evil* (Henry Regnery Co.)  
*The Use and Abuse of History* (Liberal Arts Press)
- Peirce: *Essays in the Philosophy of Science* (Liberal Arts Press)  
*Philosophical Writings of Peirce* (Dover Pubns.)
- Russell: *The Conquest of Happiness* (N.A.L.W.L.)  
*The Analysis of Matter* (Dover Pubns.)  
*An Essay on the Foundations of Geometry* (Dover Pubns.)
- Santayana: *Skepticism and Animal Faith* (Dover Pubns.)  
*The Sense of Beauty* (Dover Pubns.)  
*Three Philosophical Poets* (Doubleday & Co.)  
*Character and Opinion in the United States* (Doubleday & Co.)
- Sartre: *Intimacy* (Avon)  
*Exit and Three Other Plays* (Alfred A. Knopf)  
*Rock Wagram* (N.A.L.W.L.)
- Whitehead: *Adventures of Ideas* (N.A.L.W.L.)  
*Aims of Education* (N.A.L.W.L.)  
*Science and the Modern World* (N.A.L.W.L.)
2. *Titles from Other Contemporary Philosophers*
- A. J. Ayer: *Language, Truth and Logic* (Dover Pubns.)
- M. Buber: *Between Man and Man* (Beacon Press)  
*The Writings of Martin Buber* (Noonday Press)
- E. Cassirer: *An Essay on Man* (Doubleday & Co.)  
*The Myth of the State* (Doubleday & Co.)  
*The Philosophy of the Enlightenment* (Beacon Press)  
*Substance and Function and Einstein's Theory of Relativity*  
(Dover Pubns.)  
*Theory of Relativity* (Dover Pubns.)  
*The Renaissance Philosophy of Man* (Univ. of Chicago Press)
- B. Croce: *History as the Story of Liberty* (Noonday Press)
- M. C. D'Arcy: *The Mind and Heart of Love* (Noonday Press)  
*Communism and Christianity* (Penguin Books)
- C. J. Ducasse: *Art, the Critics and You* (Liberal Arts Press)
- S. Hook: *The Hero in History* (Beacon Press)  
*Marx and the Marxists: The Ambiguous Legacy* (Van Nostrand  
Co.)
- S. Langer: *An Introduction to Symbolic Logic* (Dover Pubns.)  
*Philosophy in a New Key* (N.A.L.W.L.)
- R. Niebuhr: *An Interpretation of Christian Ethics* (Noonday  
Press)

- J. Stalin: *Dialectical and Historical Materialism* (International Press)
- P. Tillich: *The Religious Situation* (Noonday Press)
3. *Paperback Anthologies*  
 Runes (ed.), *Living Schools of Philosophy* (Littlefield Adams)  
 White (ed.), *The Age of Analysis* (N.A.L.W.L.)
- B. *Anthologies*
1. *General*  
 Jarrett and McMurrin (ed.), *Contemporary Philosophy* (Henry Holt & Co.)  
 Runes (ed.), *Twentieth Century Philosophy* (Philosophical Lib.)  
 Also available in paperback, under title *Living Schools of Philosophy*, as noted above.  
 White (ed.), *The Age of Analysis* (Houghton-Mifflin Co.)  
 Also available in paperback, as above.
2. *Special Topic or Group*  
 Feigl and Brodbeck (ed.), *Readings in the Philosophy of Science* (Appleton-Century-Crofts)  
 Feigl and Sellars (ed.), *Readings in Philosophical Analysis* (Appleton-Century-Crofts)  
 Fisch (ed.), *Classic American Philosophers* (Appleton-Century-Crofts)  
 Includes Peirce, James, Dewey, Royce, Santayana, Whitehead.
3. *Individual*  
 Dewey: Ratner (ed.), *Intelligence in the Modern World* (Modern Lib.)  
 Edman (ed.), *The Philosophy of John Dewey* (Bobbs-Merrill)  
 Kierkegaard: Bretall (ed.), *A Kierkegaard Anthology* (Princeton Univ. Press)  
 Auden (ed.), *Kierkegaard* (David McKay Co.)  
 Maritain: Evans and Ward (ed.), *The Social and Political Philosophy of Jacques Maritain* (Chas. Scribner's Sons)  
 Nietzsche: Wright (ed.), *The Philosophy of Nietzsche* (Modern Lib.)  
 Kaufmann (ed.), *The Portable Viking Nietzsche* (Viking Press)  
 Santayana: Cardiff (ed.), *Atoms of Thought* (Philosophical Lib.)  
 Whitehead: Northrup and Gross (ed.), *A Whitehead Anthology* (Macmillan Co.)
- C. *Evaluations from the Thomist Standpoint*
1. *General*  
 Vincent E. Smith, *Idea-Men of Today* (Bruce Pub. Co.)

## 2. *Special*

The relevant works of Maritain, Collins, and D'Arcy have been noted above.

Richard Butler, *The Mind of Santayana* (Henry Regnery Co.)

James Collins, *A History of Modern European Philosophy* (Bruce Pub. Co.)

For Nietzsche and Bergson

Regis Jolivet, *Introduction to Kierkegaard* (Dutton & Co.)

John M. Oesterreicher, *Walls are Crumbling* (Devon-Adair).

For Bergson and Husserl

Kurt F. Reinhardt, *The Existentialist Revolt* (Bruce Pub. Co.)

## Report on the Ninth Annual Meeting of the Missouri State Philosophy Association

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The ninth annual meeting of the Missouri State Philosophy Association was held Friday and Saturday, October 12 and 13, 1956, at Westminster College, Fulton, Missouri. As in the past, the program consisted of three unrelated papers presented Friday afternoon, each followed by discussion; the annual association dinner, followed by the presidential address and the business meeting on Friday evening; and a symposium of three related papers, concluded by discussion from the floor, on Saturday morning.

The first paper of the Friday afternoon session, "A Typological Analysis of Social Understanding," was read by Robert S. Trotter of William Jewell College. This typological analysis, having nothing to do with "typology" as this is sometimes understood in the social sciences, consisted in a careful characterization of the different kinds and levels of analysis used in the attempt to *understand* social phenomena. While Professor Trotter modestly insisted upon the provisional character of the five general types or kinds delineated, his categories represent eminently useful tools and demonstrate genuine insight into the nature, limitations, and advantages of each of the kinds of analysis discussed. The paper had the outstanding virtue of insisting that the term "scientific" not be restricted to "objective analyses", as these were defined, but be used with equal justification for the "non-objective" forms.

Mrs. Eleanor Elrod of Fulton followed with a paper on "The Idea of Semblance as Developed by Suzanne Langer." This paper consisted of an accurate statement of Mrs. Langer's views concerning the purely formal aspects of art as expressed in her book, *Feeling and Form*. For those acquainted with Mrs. Langer's work it was disappointing that the speaker limited herself strictly to reporting Mrs. Langer's position, leaving no room in the paper or in the discussion for criticism and evaluation.

The final paper of the afternoon, "Substance and Causality in Whitehead," by Leonard J. Eslick of Saint Louis University, consisted of a penetrating analysis of the problem of substance and causality in Whitehead and Aristotle, demonstrating not only the inadequacy of Whitehead's understanding of the Aristotelian position, but also showing the fundamental failure of Whitehead to provide an alternative solution. This paper, by far the most weighty philosophically, elicited a spirited and stimulating exchange which, cut short for lack of time, was continued throughout the remainder of the afternoon and evening on an informal basis.

The presidential address by Professor Arthur Berndtson of the University of Missouri was devoted to "Beauty, Embodiment, and Art." His carefully worked out esthetic position met with considerable interest and response.

On Saturday morning A. Duff Gordon (Park College), Donald C. Hodges (University of Missouri) and Byron L. Osborne, Jr. (Stephens College) contributed to a symposium on "The Limits of Government." The discussion of these papers centered about the moral grounds for resistance by the individual to unjust governmental legislation and executive pressures. The symposium was, on the whole, disappointing. The outstanding contribution, that of Professor Hodges of the University of Missouri, was received with little understanding. There seemed to prevail a general reluctance to engage in a real exchange on this topic of current interest.

In its business meeting the Association voted to continue and extend its questionnaire survey of the offerings in philosophy and the staffs engaged in teaching philosophy in the colleges and universities of the state. It was decided also to accept the urgent invitation of the Senate Subcommittee on Disarmament and to approve the designation of six members of the Association who would contribute papers on the moral issues relevant to disarmament and testify at the hearings in Saint Louis on December 12. Linus J. Thro, s.j., of Saint Louis University was elected President of the Association for the ensuing year and Donald C. Hodges of the University of Missouri was re-elected Secretary-Treasurer. Next year's meeting, it was determined, would be held at Washington University in Saint Louis, where Morris Eames will be in charge of the program and arrangements.

Octave Hamelin, in his study of Aristotelian philosophy,<sup>1</sup> writes that the theory of modal syllogisms and propositions is one of the most difficult and least known parts of the *Prior Analytics*. Aristotle's treatment of the matter<sup>2</sup> does not appear equal to his great achievements in other areas. Despite widespread opposition, it seems that ancient thinkers had no acceptable substitute to offer. The purpose of this paper is to examine some of the principles on which Aristotle builds his theory of modal reasoning and to suggest a tentative reconstruction which would eliminate the shortcomings of his exposition.<sup>3</sup>

The modal syllogism is one in which either both premises are modal propositions or one premise alone is modal and the other assertoric. Assertoric propositions simply state that a predicate belongs to a subject whereas modal propositions also express the manner or mode of belonging.

The nature of the assertoric must be clearly determined before examining the various cases of modal inference. Among the examples given by Aristotle in the *Prior Analytics*, we find propositions such as "All animals are in motion" (i. 30a30), "Every man is an animal" (i. 31a15), "No intelligent thing is a crow" (i. 34b33), "No white thing is an animal" (i. 30b33), "Some man is not awake" (i. 31b40), "Some snow is not an animal" (i. 35b10). In some cases the composition or division of subject and predicate is necessary; in others, not. It should not be arbitrarily assumed with Albert the Great<sup>4</sup> that the assertoric must sometimes express a necessary connection of subject and predicate. It simply states that the predicate belongs to the subject.<sup>5</sup>

The four modes which are most commonly considered in traditional logic are necessity, impossibility, possibility, and contingency. Since impossibility is a negative necessity, its case does not differ basically from that of necessity: the impossibility of the *A* is the necessity of the *E*. There are many types of necessity: the necessity resulting from the will and power of an agent, fictional necessity and the necessity of the rules in games, the necessity of past events as past, moral necessity, the necessity of essential connection corresponding to something actually existing or at least based on hypothetical existence. The last kind of necessity is the most common in logic; it is found whenever the predicate represents something of the subject's essence or an essential property. To avoid confusion, necessity should always be given the same meaning in any one syllogism.

As for contingency and possibility, their meanings are very intimately

connected. The mode of contingency states a conjunction of possibility and negation of necessity. The difficulty of rendering the Greek words for these modes is evidenced by the variety of expressions used in the translations of the *Prior Analytics*.<sup>6</sup> Aristotle himself seems to use *endechomenon* and *danaton* equivalently. The dictums of the possible propositions given as examples by Aristotle never show a necessary connection between subject and predicate; either the dictum states something that will be true in the majority of cases (*ut in pluribus*), or it states something which can just as well be as not be. The former kind of possibility could be called natural possibility or probability (*pephukos*); and the latter, indefinite or indifferent possibility (*aoriston*).<sup>7</sup> Thus it is naturally possible for a man's hair to turn gray with advancing age, though in some cases this does not happen. It would also be possible for an aging man not to turn gray, though this would be neither naturally nor indefinitely possible but exceptionally possible.<sup>8</sup> Dictums that could be true only through an unusual array of circumstances, even when they do not state exceptions to the laws of nature, should perhaps be termed exceptionally possible.

It should never be supposed from a purely formal standpoint that the possible is necessary, though, strictly speaking, the possible does not deny necessity but is its subaltern. If mere possibility is stated, necessity is ex-

<sup>1</sup>*Le Système d'Aristote*, (Paris: Alcan, 1920), p. 189.

<sup>2</sup>*Prior Analytics* i. 29b29-40b17.

<sup>3</sup>Theophrastus's objection to Aristotle's analysis amounts to a destruction of this section of the *Prior Analytics*. It is not only a simplification or an improvement of Aristotle's teaching, as Ross suggests. Cf. W. D. Ross, *Aristote* (Paris: Payot, 1930), pp. 55-56.

<sup>4</sup>*Opera Omnia* (Paris: Vives, 1890), Vol. I, p. 522, col. 2 and *passim*.

<sup>5</sup>*Prior Anal.* i. 30a28; cf. Joannis Philoponi *In Aristotelis Analytica Priora Commentaria* (Berlin, 1905), p. 124, ll. 21-22: "Such is then the nature of the assertoric that it is possible for whatever is asserted of the subject not to be asserted of it."

<sup>6</sup>Tricot uses *contingent*. Tredennick ("Loeb Classical Library" translation) uses both *problematic* and *possible*. Albert the Great's Latin paraphrase resorts to *contingens*.

<sup>7</sup>See *Prior Anal.* i. 32b5-15.

<sup>8</sup>Aristotle gives as examples of possibles the possibility of a man's hair turning

gray as well as the possibility of a man's hair not turning gray (*ibid.*, 32b7 ff.), the possibility that an animal is walking or that an earthquake is happening while it is walking (*ibid.*, 32b13-14). It should be noted that propositions are termed possible or probable in two ways. Subjective possibility or probability merely reflects the imperfect state of our knowledge of a given matter; objective possibility on the other hand is founded on the objective nonrepugnance of the connection expressed by the proposition.

<sup>9</sup>Cf. *ibid.*, 32a19 ff.

<sup>10</sup>Cf. Albert the Great, *Opera*, Vol. I, p. 526 col. 1. G. H. von Wright expresses the same idea in *An Essay in Modal Logic* (Amsterdam: North Holland Publishing Co., 1951), p. 24: "A necesse esse ad esse valet consequentia."

<sup>11</sup>*Prior Anal.* i. 29a30-29b1; Albert, *Opera*, Vol. I, p. 467, col. 1.

<sup>12</sup>*Prior Anal.* i. 25a6-21.

<sup>13</sup>*Ibid.*, 25a26-36.

<sup>14</sup>*Ibid.*, 25a40-b2.

<sup>15</sup>*Ibid.*, 32a30-b5; cf. Hamelin, *Le Système d'Aristote*, p. 194.

cluded; the stronger mode should be affirmed if it applies.<sup>9</sup> Whereas the mode of necessity signifies both actual predication and the necessity of predication,<sup>10</sup> the mode of possibility merely indicates the possibility of predication without involving actual predication; in the case of the naturally possible, however, the predicate is known to belong to the subject *ut in pluribus*. The contingent on the other hand seems to involve not only possibility and negation of necessity but also actual predication. An identification of the contingent with Aristotle's *endechomenon* would not be consistent with his theory of the conversion of possibles.

### Reduction of Modal Syllogisms

Aristotle distinguishes between the perfect syllogisms whose conclusions follow necessarily from their premises by an evident application of the principles *dictum de omni*, *dictum de nullo*, and the syllogisms of the second and third figures which are imperfect. The latter conclude necessarily, but the logical principles are shown to apply to them by a reduction to the first figure.<sup>11</sup> In the process of reduction, the terms of an imperfect syllogism are rearranged to form a syllogism of the first figure.

Conversion is an important method of reduction. Among assertoric propositions, the *A*, *I*, *E* convert to *I*, *I* and *E* respectively; the *O* does not convert.<sup>12</sup> The necessary modal propositions convert in the same manner as the assertoric.<sup>13</sup> The *A* and *I* possibles convert to *I* possible.<sup>14</sup> Conversion of the *E* and *O* possibles is rejected on the basis of the definition given for the mode of possibility. To prove this, Aristotle introduces another kind of conversion restricted to possibles and which merely involves a change of quality in the dictum without interchange of subject and predicate.<sup>15</sup> We shall call this operation qualitative conversion to distinguish it from ordinary conversion. By qualitative conversion, *E* possible converts to *A* possible and vice versa, *I* possible to *O* possible and vice versa. Evidently *E* possible would not be true if there existed a necessary relationship between some part of the subject of *E* and its predicate. Nor would qualitative conversion of *I* be admissible if it were compatible with the corresponding necessary *A*, since that would imply the falsity of the possible *O* and prevent qualitative conversion. Thus if it is possible that some horses are white, it is also possible that some horses are not white; and if it is possible that all men are awake, it is also possible that no man is awake. The above procedures obviously apply to indefinitely possible propositions. The naturally possible *A* or *E* could not undergo qualitative conversion except perhaps to exceptionally possible *O* and *I*. The naturally possible *O* and *I*

would also convert to exceptionally possible *I* and *O*.<sup>16</sup> In any case, one should always assume, unless otherwise stated, that the possible referred to in the modal analysis is the indifferently possible. The sciences are concerned of course with the natural possible,<sup>17</sup> not with the indifferent or indefinite possible whose truth does not even exclude the truth of the opposite with which it is convertible. It remains nonetheless that the indifferent possible may be construed as formally prior to, and including within, its indefiniteness both the natural and the exceptional possible; it then becomes the possible without qualification.

If we revert to the meaning of conversion as an interchange of subject and predicate, we can show that *E* and *O* possibles are not convertible in this manner. Obviously *O* possible cannot undergo this kind of conversion, for we would be extending a term in the dictum; for example, if "some intelligent thing may not be a man," it does not follow that "some man may not be an intelligent thing." The possible *E* presents a special difficulty, since the corresponding assertoric and necessary statements are simply convertible. However, Aristotle demonstrates that it cannot be simply converted. If it is true that "possibly no *B* is *A*," simple conversion is not feasible to "possibly no *A* is *B*." For if "possibly no *B* is *A*" is true, "possibly all *B* is *A*" is also true by qualitative conversion. Assuming "possibly no *A* is *B*" to be true, then "all *A* may be *B*" is also true. But if "all *B* may be *A*," it does not follow that "all *A* may be *B*," since the *A* possible converts

<sup>16</sup>Cf. Albert, *Opera*, Vol. I, p. 539, col. 2. The complexity of this matter also calls for a distinction between the viewpoints of extension taken in its entirety and extension taken with reference to the separate individuals. Whereas it is naturally possible for a predicate to belong to a given subject because it signifies an attribute belonging to the subject in most cases, it is only exceptionally possible, in the physical order and given a sufficient number of individuals, that the attribute should belong to the *entire* extension of the subject. Thus the proposition that "all aging men turn gray," though naturally possible because the attribute signified by the predicate is naturally possible for each man taken separately, is only exceptionally true of the extension taken in its entirety. By stressing each inferior contained in the universal subject rather than the totality of inferiors, the naturally possible *A* and *E* could of course undergo qualitative conversion to exceptionally pos-

sible *E* and *A* (cf. *Prior Anal.* i. 32b5-18).

<sup>17</sup>Cf. *Prior Anal.* i. 32b18-23. Apparently the Aristotelian theory of the conversion of possibles (*ibid.*, 32a16-40) applies in a very restricted sense to natural possibles. Aristotle himself notes a difference between qualitative conversion of the natural possible and of the indefinite possible (*ibid.*, 32b15-18).

<sup>18</sup>*Ibid.*, 36b35-37a15.

<sup>19</sup>*Ibid.*, 29b35-30a4; cf. Hamelin, *Le Système d'Aristote*, p. 222.

<sup>20</sup>*Prior Anal.*, i. 30a5-15.

<sup>21</sup>*Ibid.*, 30a15 ff.; Albert, *Opera*, I, 522; Hamelin, *Le Système d'Aristote*, pp. 202-3.

<sup>22</sup>*Prior Anal.* i. 30a15-30b7.

<sup>23</sup>*Ibid.*, 30b7-31a18.

<sup>24</sup>*Ibid.*, 31a18 ff.

<sup>25</sup>*Ibid.*, 30a15-24; also Alexander of Aphrodisias, *In Aristotelis Analytica Priora I Commentaria* (Berlin, 1883), p. 126, ll. 1 ff.

to an *I*. Yet we would have to admit this if "possibly no *B* is *A*" is simply converted by ordinary conversion.<sup>18</sup> However, it would seem that partial conversion from "possibly no *B* is *A*" to "some *A* may not be *B*" is acceptable. Thus, of the four possibles *A*, *E*, *I*, and *O*, the first three convert to *I*, *O*, and *I* respectively, whereas *O* does not convert by ordinary conversion.

Another method of reduction is the proof by contradiction or reduction to the impossible. It consists in taking the contradictory of the conclusion and coupling it with one premise to construct a modal syllogism in the first figure. The resulting conclusion should not be compatible with the omitted premise if the original syllogism is correct.

### **Both Premises Necessary**

When both premises are necessary, the conclusion is always necessary.<sup>19</sup> The same moods (direct and indirect) which are correct for assertoric premises are also acceptable when the premises are necessary modal propositions. "Barocco" and "bocardo" can only be reduced to the first figure by substituting for the undistributed subject a term *C* such that some *B* equals all *C*,<sup>20</sup> since the normal reduction by contradiction would yield a mixture of necessary and possible premises.

### **Mixture of Necessary and Assertoric Premises**

Aristotle and many others after him teach that if one premise is assertoric and the other necessary, a necessary conclusion sometimes follows.<sup>21</sup> He states that the conclusion in the first figure will be necessary if the major is necessary, whether the syllogism is universal or particular.<sup>22</sup> In the second figure, the conclusion will be necessary only if the universal negative is necessary, for such syllogisms are reducible to those of the first figure which have a necessary conclusion.<sup>23</sup> Finally Aristotle writes that syllogisms of the third figure will have a necessary conclusion if, in affirmative syllogisms, the universal affirmative is necessary and, in negative syllogisms, the universal negative is necessary.<sup>24</sup>

The syllogisms of the second and third figures are proved by reduction to the first; hence it suffices to consider the moods of the first figure to determine whether a necessary modal conclusion can ever be drawn from a mixture of assertoric and necessary premises. According to Aristotle, if the major in one of the four direct moods is a necessary modal, the conclusion will also be a necessary modal. He reasons that the major term (for instance, in "barbara") belongs necessarily to the minor term since the major term belongs necessarily to the middle term and the minor term is but a part of the extension of the middle term.<sup>25</sup> Indeed, it would be quite

difficult to defend this portion of Aristotle's teachings. It does not seem that a mixture of assertoric and necessary premises can ever produce a necessary conclusion. Because *A* belongs necessarily to all *B* and *B* belongs simply to *C*, it does not follow that *A* must belong to *C*. Thus if "all lawyers must have passed the bar examination" and "all the councilmen of a given town are lawyers," it follows simply that "all the councilmen of the town have passed the bar examination." As in the example, the terms can be such that the connection between *A* and *B* is necessary while the connection between *B* and *C* is actual though not necessary.<sup>26</sup> Then it appears that a necessary conclusion cannot be drawn. It could be said in defense of Aristotle that *A* necessarily belongs in reality to the things signified by *C*, insofar as *A* is necessarily identified with *B* of which *C* is a logical part. But whereas necessity governs the relationship between *B* and *A*, no necessity can be inferred for the relationship between *C* (considered as *C*, not just as some *B*) and *A*. In the example given above, there is no necessity that councilmen as such have passed the bar examination.

Aristotle's doctrine is at the origin of a lively controversy in Greek philosophy. According to Ammonius,<sup>27</sup> the Platonists as well as Theophrastos and Eudemos refuse to admit that a necessary conclusion follows from a mixture of necessary and assertoric premises; but the commentator points out that, among more recent thinkers, Alexander and Iamblichos side with Aristotle, while Themistius, Surianos, and Proclus oppose him. Thus

<sup>26</sup>John Philoponos states the same objection in his commentary on the *Prior Analytics*, p. 124, ll. 24-28. It is suggested that Aristotle's rule does not hold for terms such as "motion," "walking," "man" or "virtue," "prudence," "man."

<sup>27</sup>Ammonius, *In Aristotelis Analyticorum Priorum I Commentarium* (*Commentaria in Aristotelem Graeca*, Vol. 4, Part 6 [Berlin, 1899]), p. 38, ll. 38 ff.; see also Alexander, *In Arist. Comment.*, p. 124, ll. 8 ff.

<sup>28</sup>Cf. Alexander, *In Arist. Comment.*, p. 124, ll. 8-17; also John Philoponos, *In Arist. Comment.*, p. 126, ll. 2 ff.

<sup>29</sup>Cf. Ammonius, *In Arist. Comment.*, p. 40, ll. 5-7.

<sup>30</sup>Albert the Great, *Opera*, I, 523.

<sup>31</sup>*Prior Anal.* I. 30a28.

<sup>32</sup>Some ancient Greek interpreters attempt to justify Aristotle's theory on the ground that it holds only for those assertories whose subject and predicate are necessarily related (cf. Alexander, *In Arist. Comment.*, p. 125). Alexander dis-

misses this interpretation as ridiculous and empty. Ammonius identifies a certain Herminos as proposing such a solution (*In Arist. Comment.*, p. 39, ll. 31-32). Such explanations completely overlook the formal viewpoint adopted by Aristotle in his exposition of the rules of inference. Iamblichus, according to Ammonius (p. 40), distinguishes between the assertoric that inclines to the necessary and that which inclines to the possible; the first type would combine with a necessary modal to produce a necessary modal conclusion.

<sup>33</sup>This doctrine was attributed to Aristotle from the earliest times. There is evidence that the chapters in which it is expounded (chaps. 8-22) were hastily written (cf. 35a2). Lukasiewicz looks upon this part of the *Analytics* as a later insertion (*Aristotle's Syllogistic* [Oxford: Clarendon Press, 1951] p. 131, n. 1). It seems more likely to have been an earlier experimental piece of work than the product of a more mature consideration.

Aristotle's doctrine does not appear to have met with the approval of his contemporaries and immediate successors, though later it did gain the acceptance of some commentators.

The opponents point out that the assertoric is "inferior" to the necessary; hence to draw a necessary conclusion from a mixture of assertoric and necessary premises constitutes a violation of the principle that *pejorem semper sequitur conclusio partem*.<sup>28</sup> They find it significant that Aristotle fails to demonstrate by means of terms the cases in which he draws a necessary conclusion from a mixture of premises.<sup>29</sup>

Albert the Great, presumably not wishing to contradict Aristotle's authority yet sensing the fallacy, holds that the assertoric referred to is one in which the connection between subject and predicate is necessary (*C substantialiter est sub B*).<sup>30</sup> This interpretation supposes that Aristotle gives radically different meanings to the same words in the same context but without indicating the shift in meaning. However, Aristotle's own text contradicts Albert's interpretation; the text<sup>31</sup> describes an assertoric as a proposition in which *A* belongs to *B* but could very well not belong to it. This does not eliminate necessary predication in the assertoric form but distinguishes the simple assertoric statement of such a predication from its modal expression inasmuch as the assertoric considered as such does not exclude, in a purely formal sense, the possibility of its opposite. In considering the case of mixed necessary and assertoric premises which is recognized not to yield a necessary conclusion, Albert takes a view of the assertoric which is opposed to his first interpretation and conforms to Aristotle's definition; then, he states, if the conclusion is necessary, it is not *virtute syllogistica* but *gratia materiae*. An application of the same principle to the first case would show that here too a necessary conclusion can result only *gratia materiae*, not *virtute syllogistica*. If "all animals must be organic" and "all white things are animals," it follows that "all white things are organic," not that "all white things must be organic." Some will contend that "white things" is a part of the extension of "animal" and may be the subject of a proposition in which "organic" is predicated with necessity. But if "white things" is simply the particular of "animal," it seems that syllogistic progress is destroyed; "white" is a term in its own right, not simply "some animal," nor should it be considered such in the conclusion which is not a mere reformulation of the major premise but a new truth. It follows that the teaching of the *Prior Analytics* is at fault on this point.<sup>32</sup> Since the examination of syllogisms with mixed assertoric and necessary premises sets the tone for much of Aristotle's later developments, the entire modal analysis appears inadequate and, in many respects, even facetious.<sup>33</sup>

## Syllogisms with Possible Premises

If the premises are natural possibles, the conclusion will also be a natural possible.<sup>34</sup> But if the possibles are indefinite possibles, no conclusion can be drawn, since two indefinite possibles may express a logical potency for opposites; that is, two incompatible terms may be coupled with the same middle term in possible premises. It does not follow from "all men may be black" and "all white things may be men," that "possibly all white things are black." The possible states the consistency of a connection between subject and predicate, irrespective of the truth or falsity of the connection; it cannot be made to signify the consistency of a dictum in which opposites are identified.

Syllogisms in which the indefinite and natural possibles are mixed lead to a conclusion provided the corresponding assertoric mood is correct and provided the indefinite possible is not equivalent to the modal converse of the natural possible (for example, no conclusion could be drawn from the propositions that "it is naturally possible that aging men turn gray" and "it is possible that aging men retain their dark hair"). As for syllogisms in which there is a mixture of assertoric and indefinite possible, it would seem that no conclusion can follow with logical necessity, since the assertoric (for instance, "The buying power of the dollar is increasing") could always state something which, in terms of possibility and without reference to actual existence, would be indefinitely possible; hence the objection to syllogisms with two indefinitely possible premises extends to the mixture of assertoric and indefinitely possible premises. If the syllogism has one assertoric and one naturally possible premise, a conclusion could be drawn as in the case of the mixture of indefinitely possible and naturally possible premises; but it could be no more than indefinitely possible unless the assertoric happens to state a necessary connection between subject and predicate. From a strictly formal viewpoint, however, not one of the mixtures considered in this paragraph would necessarily yield a conclusion; it is always possible to conceive of terms for which no conclusion can be inferred.

### Mixture of Necessary and Possible Premises

A mixture of necessary and naturally possible premises leads to a naturally possible conclusion for all the correct moods. But special cases arise with a mixture of necessary and indefinitely possible premises. Because of qualitative conversion of the indefinitely possible premise, it is possible

<sup>34</sup>For example, all who turn gray may suffer from an X deficiency. But all aging men may turn gray. Therefore all aging men may suffer from an X deficiency.

to draw conclusions with moods that would not be correct with assertoric premises. For example, the mood having a necessary *E* as major and a possible *A* as minor is equivalent to the mood having a necessary *E* major and a possible *E* minor (for instance, "No lawyer can be ignorant of the law. But it is possible that all the trustees are lawyers," or by qualitative conversion, "It is possible that no trustee is a lawyer. Therefore it is possible that no trustee is ignorant of the law"); thus mood *EE* would lead to a conclusion with this mixture of modal premises because it is reduced to *EA* by qualitative conversion. Modal analysis would show that, whenever a conclusion follows from two assertoric premises, a conclusion will also follow from a mixture of necessary and indefinitely possible premises, and the conclusion will always be indefinitely possible. However, even in the moods which cannot conclude either directly or indirectly with two assertoric premises, there may still be a conclusion if one premise is an indefinitely possible proposition, since indefinitely possible propositions are convertible into their opposites; for example, "It is possible that no *A* is *B*" converts to "It is possible that all *A* is *B*." In this manner, besides the correct moods for assertorics, other moods conclude either directly or indirectly by conversion of the indefinitely possible premise (for instance, *EE* and *OE* in all figures). In syllogisms where the usual reduction to the first figure is not feasible owing to the impossibility of ordinary conversion of the *E* and *O* possibles, the moods can be proved by contradiction. All such cases, though perhaps theoretically interesting, have no practical significance.

### Modal Syllogisms Having Contingent Premises

If the premises are both contingent in the sense defined above, the conclusion in all the correct moods will be contingent. A mixture of necessary and contingent premises yields a contingent conclusion. The conclusion drawn from a mixture of assertoric and contingent premises can be stated indifferently as an assertoric or as a contingent proposition. A contingent premise coupled with a possible premise will not necessarily lead to a conclusion, since the contingent may state a fact inconsistent with the dictum of the possible premise. What was said previously about the mixture of assertoric and possible premises also applies to the present case.

### Conclusion

Much of Aristotle's modal analysis is not very useful to the advancement of knowledge. Lukasiewicz looks upon it as "an extension of logic, but

probably not in the right direction."<sup>35</sup> The mind does not make significant progress in its search for truth by formulating a possible composition of subject and predicate which implies at the same time a possible division of the terms.<sup>36</sup> If on the other hand the connection is necessary or even naturally possible, the mode would normally be omitted in reasoning and the proposition would be stated in the form of an assertoric.<sup>37</sup> It is, however, important for completing the theory of logical inference to work out the implications of modal premises or of mixtures of modal and assertoric premises.

This article has attempted to indicate a number of elements which are essential to any analysis of modal reasoning. The modes should be carefully defined and the nature of the assertoric determined. The theory of the figures and moods of correct reasoning from assertoric premises is presupposed, though it remains open to certain modifications resulting from the modal conversion of possible premises. The principle of *pejorem semper sequitur conclusio partem* would also seem to have some application to modal reasoning. Thus necessity is the strongest mode. Natural possibility is stronger than indefinite possibility, but a conclusion can only be drawn from the mixture of natural and indefinite possibles by an interpretation of the matter (*gratia materiae*). The same holds true for the mixture of natural possible and assertoric or contingent premises. From the purely formal standpoint, the assertoric and the contingent are of equal strength, despite the fact that the contingent excludes necessity. The indefinite possible (as including the exceptionally possible) is weaker than both the assertoric and the contingent, but no conclusion would follow in a strictly formal sense from such mixtures.

In conclusion, it appears that Theophrastus was right in requiring that the principle *pejorem semper sequitur conclusio partem* be applied to the modes as well as to the quantity and quality of propositions. However, it is clearly not sufficient to solve all the problems which confront the mind in modal reasoning. As we have suggested, other factors must be considered in determining the correctness of modal inferences.

<sup>35</sup>Aristotle's *Syllogistic*, p. 131.

<sup>36</sup>Although Aristotle acknowledges the feasibility of a syllogism having indefinitely possible premises, he discounts the importance of such propositions (*Prior Anal.* i. 32b18-23). However, to explain the correctness of syllogisms having a mixture of assertoric and naturally possible

premises, it is necessary, as we have indicated above, to understand the syllogisms with indefinitely possible premises.

<sup>37</sup>Cf. G. Grote's sweeping condemnation of the section of Aristotle's *Prior Analytics* dealing with the modal syllogisms (*Aristotle* [London: John Murray, 1872] pp. 294 and 297).

## WANTED: More Subjectivity in Truth

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Students of our American Catholic schools are told repeatedly of the objectivity of truth. They realize that you cannot pick and choose what you wish to be true. There is danger, however, that a one-sided emphasis on the objectivity of truth fails to point up the equally necessary subjectivity of truth. This subjectivity of truth is a neglected stepchild in the family of Catholic education. That such is the case may partially be seen in the following episode.

A somewhat agitated student recently approached a professor of philosophy at a Catholic college, impatiently complaining, "Why do we waste so much time trying to understand these other, non-Catholic philosophers? When are you going to give us the Catholic position?" Since the professor was interested in having his students make the effort to see a properly philosophical *problem*, his answer to the latter question was a curt "Never."

Now, admittedly, this is only a single instance of an intellectual abdication by a Catholic student. However, it points to a situation within the Catholic educational system which is receiving the attention of increasing numbers of cautious and competent critics. I refer to the rising tide of self-evaluation and criticism of our Catholic schools in terms of their apparent inability to train proportionately enough intellectual leaders, whether in the areas of the sciences, letters, or the humanities. This criticism embraces the entire system of Catholic education, since intellectual habits are begun as early as the primary grades.

These critics pay genuine tribute to those numerous pioneers, both lay and clerical, who sacrificed so much in their indefatigable efforts to found and foster this magnificent system of American Catholic schools. Tribute is paid also to those of our own day whose daily lives of sacrifice are a necessary factor structuring this system. For the most part, they are aware of the historical circumstances surrounding the origin and growth of our schools and their primarily religious role of conserving and nourishing the faith. But, they ask, do not our schools have the additional role of preparing our youth for intellectual leadership? Have we not, perhaps, overstressed the school as an agency for moral development at the expense of an insufficient emphasis on the fostering of intellectual excellence? Given this additional role, how well are the schools fulfilling it?

Their answers are far from encouraging. Recent studies reveal the startlingly low proportion of Catholic research scientists.<sup>1</sup> Julian Pleasants, one of these, seems to think our admitted shortcomings are not due solely to

problems of school finance.<sup>2</sup> Our philosophical and theological journals reveal a scarcity of topflight American philosophers and theologians. Other critics point out that most of the Catholic authors who have commanded literary respect in this country are either not Americans or received their education in non-Catholic institutions.<sup>3</sup>

Nearly all these critics point to a tendency on the part of some Catholics to overemphasize the supernatural and other-worldly aspects of the Christian religion. This results in many taking the view that because a Christian is a pilgrim to eternity, he is a stranger in this temporal world of ours. An intellectual sloth or lack of concern for things purely intellectual or scientific consistently follows this view. Father John Tracy Ellis, historian of Church history, sums up most of this criticism in his forthright and charitable evaluation of American Catholics and the intellectual life.<sup>4</sup>

If much of this criticism is valid, then there is a definite problem facing

<sup>2</sup>Cf. R. H. Knapp and H. B. Goodrich, *Origins of American Scientists* (Chicago, 1952).

<sup>3</sup>"Catholics and Science," *Catholicism in America*, A Series of Articles from the *Commonweal* (New York, 1954), pp. 165-79.

<sup>4</sup>Cf. Dan Herr, "Reading and Writing," *Catholicism in America*, p. 194. For the extensive contributions made by converts, see David Martin, c.s.c., *American Catholic Convert Authors. A Bio-Bibliography* (Detroit, 1944). For a more optimistic appraisal of the Catholic cultural contribution to the United States, see the survey made by Theodore Maynard in his *The Story of American Catholicism* (New York, 1941), pp. 543-86.

<sup>5</sup>"American Catholics and the Intellectual Life," *Thought*, xxx (autumn, 1955), 351-88.

<sup>6</sup>"The Child Centered School—Dogma or Heresy?" *Proceedings of the American Catholic Philosophical Association*, xxix (1955), 263-74. For John Dewey and the "progressives," truth loses all speculative meaning and is concerned solely with action. In other words, truth is now an adjustment to what is to be done, and knowing becomes a knowing *how*. All the philosophical controversies on this point arise, Dewey tells us, "from the assumption that the true and valid object of knowledge is that which has being prior to and independent of the operations of

knowing. . . . If we see that knowing is not the act of an outside spectator but of a participator inside the natural and social scene, then the true object of knowledge resides in the consequences of directed action. . . . On this basis the result of one operation will be as good and true an object of knowledge as is any other, provided it is good at all; provided, that is, it satisfies the conditions which induced the inquiry" (*The Quest for Certainty. A Study of the Relation of Knowledge and Action*, "The Gifford Lectures," 1929 [New York, 1929], pp. 196-97). And since no two problems are ever exactly the same, no two knowledges and their consequences will ever be the same; and any notion of an eternally true, immutable knowledge, valid for all in every circumstance, becomes a chimera.

<sup>7</sup>See Plato, *Cratylus*, 440, for a summary statement of the problem.

<sup>8</sup>Consider the path to skepticism followed by later Academicians, Arcesilaus and Carneades.

<sup>9</sup>In their wholesome revolt against the static, unchanging world of essences of the rationalists and the idealists, the pragmatists and the naturalists have insisted on the dynamic, changing character of reality. However, they have been unable to overcome their aversion to the supposed rigidity and lifelessness of a properly intelligible reality and its petrification in abstractions.

Catholic educators. To be sure, the solution to the problem will be many-sided. Interested theologians, psychologists, educators, teachers, historians, and parents all will have something of importance to say. I should like to explore, solely from a philosophical point of view, the possible connection between this failure to produce a proportional number of intellectual leaders and a failure to emphasize an essentially subjective characteristic of truth; namely, that we are the makers of our own truths.

Note that we are not forced to choose between a completely objective and a purely subjective truth. There are ample reasons for those supporting truth's objectivity to be sensitive to those claims for its subjectivity which would deny truth any objective validity. Thus, Francis C. Wade, S.J., would suggest a "reality-centered" theory of education as opposed to the progressive "child-centered" one because of the latter's tendency to stress *methods* of thinking at the expense of *what* is thought. Such a tendency leads to a lessening, if not outright denial, of objective truth.<sup>5</sup> However, since true knowledge can be considered as subjective in different ways, there are some rather serious consequences of overstressing its objectivity and overlooking its subjectivity which affect the problem under discussion.

Certainly, I do not wish to imply in any way that Catholic educators are unaware of these subjective characteristics of truth. What I do say is that many students, hearing from their teachers a constant stressing of truth's objective validity, fail to see their own necessarily subjective relationship to true knowledge. It is this failure, I think, that ought to be related to our deficiencies in the matter of intellectual leadership.

Let us set aside, first of all, that illegitimate subjectivism which would claim that each thing is only as it appears to *me*. My true knowledge, then, is unique, enclosed within my limited view of reality, incommunicable, and valid for no one else. In this view, reality is in a state of constant flux, never "standing still" long enough to truly *be*. Knowledge is the fleeting, instantaneous relation of a changing knower to an ever-changing reality. How could such a knowledge, never abiding and enclosed within that unique perception, be valid for another?<sup>6</sup> Historically, when such a view of sensible reality is not complemented by an other-worldly view of a stable, intelligible reality, skepticism is the result.<sup>7</sup> Many modern thinkers, sharing this view of sensible reality as radically unintelligible, restrict their skepticism to moral values, inconsistently maintaining a faith in scientific certitude.<sup>8</sup>

A realist philosopher would recognize, however, that the knowability—in fact, the very existence—of anything is due to its being known by the creative knowledge of God. That is to say, each thing is, and is the way that it is, because God creatively knows it to be, and to be in that way.

This same creative knowledge endows all human knowers with the additional power to grasp what is humanly knowable about reality. While this represents only a small part of what there is to know, still it is this power which constitutes man in the image and likeness of his Creator.<sup>9</sup> Given this knowability of reality and our power to know it, our knowledge is true when our judgment about the way reality is vitally conforms to that objective reality. True knowledge, then, is radically objective. It is always of an object and determined by that object.

But, granting this objectivity, is there nothing subjective about our true knowledge? Consider the distinction between the spheres of human knowledge and human action. To know something is not to do or make anything, nor is doing and making something knowing. Yet these two spheres are not separated in existence. It is the same man who does or makes something on the basis of what he knows. Now, certainly, Christian upholders of truth's objectivity would urge a more subjective Christianity, if subjectivity meant the lived, personal realization of the Christian truths objectively known.

This is the subjectivity of truth to which that great nineteenth-century religious thinker, Søren Kierkegaard, dedicated his prodigious literary life. Faced with an age that was officially "Christian" but was in reality far removed from the teachings of Christ, Kierkegaard vehemently insisted that truth is essentially subjective. Even preaching the truths of Christianity every Sunday and believing in them does not make a true Christian. As he said, ". . . Christianly understood, the truth consists not in knowing the truth, but in *being* the truth"<sup>10</sup> and "Christ is the truth in such a sense that to *be* the truth is the only true explanation of what truth is."<sup>11</sup>

M. Maritain has this aspect of the subjectivity of truth in mind when, in classifying atheists, he notes *practical atheists*. These are man "who

<sup>9</sup>Consider, then, the inconsistency of any Catholic "anti-intellectualism." For one discussion of the historically close connection of Christianity and intellectual endeavor, see E. Gilson, *Christianity and Philosophy* (New York, 1939).

<sup>10</sup>*Training in Christianity*, Part III, v, trans. Walter Lowrie (Oxford Univ. Press, 1941), p. 201.

<sup>11</sup>*Ibid.*, p. 200.

<sup>12</sup>*The Range of Reason* (New York, 1952), p. 97.

<sup>13</sup>Cf. Lance Wright, "The Apostolic Role of the University Graduate," *Downside Review*, (winter, 1953), pp. 50-51. See also Joseph Breig, "Preparing Youth

for Intellectual Leadership," *America*, xciii (September 3, 1955), 530-35.

<sup>14</sup>The increasing number of remedial religion classes in Catholic colleges for graduates of Catholic schools has caused many educators to make an agonizing reappraisal of current methods of teaching religion. Sister Mary Imeldis Lawler in *An Evaluation of Instructional Methods in Religion* (Catholic Univ. Press, 1947), p. 74, concluded that the all too common endless rote of questions and answers should be replaced with more vital assignments.

<sup>15</sup>"Sight, Sound and the Fury," *Commonweal*, LX (April 9, 1954), 7-11.

believe that they believe in God (and who perhaps believe in Him in their brains) but who in reality deny His existence by each one of their deeds. Out of the living God they have made an idol."<sup>12</sup> They exemplify, for Maritain, the disagreement or cleavage possible between the intellect and the will, between knowledge and actual behavior. Thus, one legitimate meaning of the subjectivity of truth would be that I consider my true knowledge as true *for me* and act accordingly.

There is another kind of subjectivity in true knowledge, however, which is more to our point. This is the subjectivity implied in saying that we make our own truth. Yes, *we* make our own truth. It is this factor in human knowing that is often overlooked in stressing its objectivity. Note, I do not say that we can make true what is untrue or vice versa. But I do say that unless *we* place ourselves, within knowledge, in a relationship of conformity with objective reality, then *we* do not have true knowledge.

At this point, distinguish between a true knowledge and knowledge of a truth. It is very easy, often too easy, to acquire knowledge of a truth. True knowledge, however, is not easy to acquire. Its acquisition is often most difficult and might represent the achievement of a lifetime's diligent searching. Why is it, then, that we can note certain current trends to make the acquisition of truth appear less arduous and more pleasant? We are living in an age of condensed literary classics and even condensed musical treasures. We have scores of books claiming to make this and that subject easy. Perhaps this is merely a state of mind reflecting the progress our age has made in the development of labor-saving devices.

However, in the case of the Catholic students, one might wonder if there is any connection between their being taught the magnificent truths of revelation by rote and their attitude toward the acquisition of other kinds of truth.<sup>13</sup> It is assumed, apparently, that they acquire some understanding of their faith with no effort other than mechanical drill and memory.<sup>14</sup> Why cannot this work also in learning other truths? Perhaps this explains why a so-called "Scholastic philosophy," as taught in manuals that ape the very rationalistic *more geometrico* they condemn, has failed in spectacular fashion to have any vital influence on contemporary philosophical dialogues.

The sad fact is that many students tend to think of truth as some *thing* which can be disclosed in textbook formulas. If this is the case, why not just memorize, why not just learn the answers, why not just acquire the jargon of truth without its comprehension? Professor McLuhan, student of contemporary communication media, describing our present-day conception of culture as excessively bookish, points up the undue reliance we have placed on the written word, making of books almost a substitute for reality.<sup>15</sup> Plato has Socrates criticize the inventor of writing in these words:

It is no true wisdom that you offer your disciples, but only its semblance; for by telling them of many things without teaching them, you will make them seem to know much, while for the most part they know nothing.<sup>16</sup>

This is not to criticize books as a medium for communicating truth but to criticize the failure to realize the essentially active, and thus objective, role of the learner in that communication.

Philosophers throughout the ages have seen this active role of the student in relation to his teacher. Some—as, for example, Socrates, Plato, and St. Augustine—would stress this essentially active side of learning, reducing the human teacher to an occasion for the student to grasp some truth. Socrates would refer to himself as a midwife, assisting at the birth of truth in one of his students. Knowing becomes a reminiscence, an uncovering by the student of what is already present, in a veiled way, to his understanding. Others, as St. Thomas, would insist on the equally active, equally necessary role played by the teacher in the learning process. It is the teacher, patiently re-creating his own true knowledge in an orderly fashion, who causes the student to reproduce this order in his own knowledge and thus acquire the taught knowledge.<sup>17</sup>

All of these philosophers, however, would reject the notion of a teacher placing ready-made truths in the minds of his pupils. As St. Thomas explained:

When they say that a teacher transfuses his learning to his pupil, this does not mean that the learning that is in the master is to be found afterward, numerically the same, in the pupil; it means that a learning similar to that of the master is caused in the pupil by the fact of his being taught.<sup>18</sup>

In his penetrating lecture, "The Eminence of Teaching," Etienne Gilson noted:

There is no use in displaying evidence before eyes that make no effort to see it; when they do see it, the reason is not that we made it so

<sup>16</sup>*Phaedrus* 275B, trans. R. Hackforth (Cambridge, 1952), p. 157. Cf. *Epistle* vii. 340B-344D.

<sup>17</sup>Cf. *De Veritate*, q. 11, a. 1; *Summa Theologiae* I, q. 84, a. 3 ad 3; *Summa contra Gentiles* II, cap. 75.

<sup>18</sup>*De Veritate*, q. 11, a. 1 ad 6, trans. Etienne Gilson in "The Eminence of Teaching," *Disputed Questions in Education* I, (New York: Doubleday, 1954).

<sup>19</sup>*Disputed Questions in Education* I, p. 24.

<sup>20</sup>*Ibid.*, pp. 27-28. Discussing the emphasis in educational theory on properly motivating the students, Sister Mary Aloise, S.N.D., "Testing for Sugar on the Slate," *Catholic Educational Review*, LI (March, 1953), 145-51, warns of the anti-intellectualism that results from a failure to teach the students to "motivate" themselves.

<sup>21</sup>*Training in Christianity*, pp. 198-99.

clear that we understood it for our pupils; sooner or later they have to understand it by themselves, and their own effort to understand it is for them the only way there is to learn it. The most scientifically pedagogical methods are bound to fail if they go against the facts of nature. In this case, the fundamental fact of nature is that no man can understand anything for another one. No master can take his own knowledge out of his mind and put it in the head of his pupils. The only thing he can do is to help them to put it themselves into their own minds.<sup>19</sup>

Thus he can conclude, "This is the true reason why the ultimate end of our pedagogy should be to teach children to learn by themselves, because, in fact, there is nothing else we can teach."<sup>20</sup>

This is the subjectivity in truth which should be pointed out and emphasized for the Catholic student if we are to develop any vigorous Catholic intellectual movement. True knowledge is hard to come by in that sense. We tend to think that once someone has succeeded in wresting some truth for himself, he has merely to speak or write that truth for all of us to have a similar true knowledge. Fortunately, or unfortunately, this is not the case with human knowledge. If *we* are to have any true knowledge, then *we* have to make that subjective effort. Kierkegaard asked:

Is 'truth' the sort of thing one might conceivably appropriate without more ado by means of another man? Without more ado—that is, without being willing to be developed and tried, to fight and to suffer, just as he did who acquired the truth for himself? Is not that as impossible as to sleep or dream oneself into the truth? Is it not just as impossible to appropriate it thus without more ado however wide awake one may be? Or is one really wide awake, is not this a vain conceit, when one does not understand, or will not understand that with respect to the truth there is no short cut which dispenses with the necessity of acquiring it . . . ?<sup>21</sup>

The implications for Catholic teachers are clear. Students must see the necessarily subjective requirements for achieving true knowledge and the special pertinence of this achievement to our own day. Rather than maintain a ghetto-like hoarding of the tremendous intellectual treasures of our Catholic heritage, they should realize the immense work to be done disseminating old truths and integrating new ones. Such was the glory of St. Thomas; such is the vocation of every Catholic intellectual. In this light, consider the added responsibility of the Catholic teacher. As Dr. Pegis concluded:

Let it be granted that man is a noble creature, but one who matures

by a physical and spiritual aging and whose growth is subject to winds of error and uncertainty. What a frail thing man is in his very nobility! Here, surely, is the burden of our vocation as teachers. We must teach the truth faithfully, yet we must teach with an enormous anxiety for those who are to receive our teaching. And if our teaching embraces the world in which man lives, because it embraces him, then our concern must be that men understand our teaching, that they share in the truth, *that they possess it in their own name, and that they live and grow in it*. Our teaching is not aimed at eternity, since eternity does not need to be taught, but at time, at the noble and frail humanity of man which needs truth in order to be human *and which must constantly renew its life in the truth in order to remain human*.<sup>22</sup>

And if we emphasize also that other subjectivity in truth which is proper to the sphere of human action—namely, that true knowledge is true *for* its possessor—then the sanctifying power of truth can be revealed as leading the doer of truth to Truth Himself. It is perhaps fitting to close with a quotation from a son of St. Dominic, Father A.-D. Sertillanges, whose already classic *The Intellectual Life* has inspired many to an ardent desire for that vocation. As he said:

By practicing the truth that we know, we merit the truth that we do not yet know. We merit it in the sight of God; we merit it also with a merit which brings its own reward; for all truths are linked together, and homage in act being the most decisive of all, when we pay that homage by living the truth of life, we draw near to the supreme light and to all that flows from it.<sup>23</sup>

<sup>22</sup>"Catholic Education and American Society," *Disputed Questions in Education* I, p. 14. Italics mine.

<sup>23</sup>*The Intellectual Life* (Westminster, Maryland, 1952), p. 23.

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*Introductory Metaphysics.* By Avery R. Dulles, s.J., James M. Damske, s.J., and Robert J. O'Connell, s.J. New York: Sheed and Ward, 1955. Pp. ix + 345. \$4.50.

*An Introduction to the Science of Metaphysics.* By Henry J. Koren, C.S.SP. Saint Louis: B. Herder Book Co., 1955. Pp. xix + 291. \$4.50.

*Introduction to the Philosophy of Being.* By George P. Klubertanz, s.J. New York: Appleton-Century-Crofts, 1955. Pp. xiii + 300. \$3.00.

*The Philosophy of Being.* By Louis De Raeymaeker. Trans. Edmund H. Ziegelmeyer, s.J. Saint Louis: B. Herder Book Co., 1954. Pp. xii + 360. \$4.95.

*The Structure of Metaphysics.* By Morris Lazerowitz. New York: Humanities Press, 1955. Pp. xiii + 280. \$5.00.

Metaphysics is a hazardous profession. The danger arises to a large extent from the extreme difficulty of being clearly and consistently aware of the distinctions between the peculiarities of our human way of knowing and the contents of our knowledge which have ontological value. Even the smallest confusion in this area can be disastrous to metaphysics as a science of real being. The metaphysics texts under review grapple with these problems with varying degrees of success.

The sub-title of *Introductory Metaphysics* by Fathers Dulles, Damske, and O'Connell indicates that it is "A Course Combining Matter Treated in Ontology, Cosmology, and Natural Theology." This intention of the authors is defended by a theory of the division of the philosophical sciences presented in the general introduction. Philosophy has three main parts: metaphysics, which studies objects existing independently of our knowledge; epistemology, which studies human knowledge; and ethics, which studies human conduct. It should be noted that this division is based on a distinction of the *objects of knowledge* rather than the more fundamental distinction of the *modes of human cognition*. If the position of the authors be taken as the adequate basis for the division of philosophical sciences, at least two serious objections can be raised. Firstly, it is impossible to have two distinct philosophical cognitions of the same real being; for example, distinct metaphysical and cosmological knowledge of material being. Secondly, the natural sciences (physics, chemistry, and so on), which also purport to study real objects, must either be parts of metaphysics or else

they deal with nonreal objects. These difficulties are avoided only by a division of sciences which includes a distinction of the various intellectual operations in the knower.

Metaphysics itself is divided in the Wolffian tradition into general metaphysics (ontology) and special metaphysics (natural theology, rational psychology, and cosmology). The inclusion of rational psychology and cosmology in metaphysics follows from the division of philosophical sciences mentioned above. This implies that all philosophical cognition of extra-mental being is metaphysical knowledge. What has happened to the philosophy of nature?

The text itself is clearly written and pedagogically well organized. The subject matter is divided into twenty-nine questions. Each chapter or question includes a statement of the problem, historical opinions, analysis and summary, supplementary notes, and suggested reading. The fundamental method used in the text is the argument from observed activities to nature and being (*agere sequitur esse*). The skillful use of this method, coupled with well-chosen inductive examples, results in an unusually clear treatment of change, multiplicity, and the principles of finite being. The principle of efficient causality is introduced as an application of the principle of sufficient reason to contingent beings. In a supplementary note Hume's arguments against the objective validity of causality are answered by an analysis of the sensio-intellectual nature of human experience of changing being. At this point the way is cleared for a discussion of the existence, nature, and activities of God, which forms the second half of the text.

Father Koren approaches his subject matter through the distinction of the three degrees of abstraction. The first degree of abstraction constitutes that level of knowledge which is physical or natural science (physics, chemistry, biology, etc.); the second degree establishes mathematics; and the third degree, metaphysics. Metaphysics includes general metaphysics (study of the concept of being) and special metaphysics (theodicy, cosmology, psychology, and philosophical anthropology). This division of sciences is open to serious objections, some of which are mentioned above in regard to the text by Fathers Dulles, Demske, and O'Connell.

Since general metaphysics is the study of the concept of being, metaphysical method is primarily an analysis of concepts. The concept of being is ontologically the first of all concepts. Its analysis reveals the principles of noncontradiction, sufficient reason, efficient causality, final causality, and even the delineation of the ten categories. The author does not make use of an inductive appeal to our experience of sensible being to establish the

ontological validity of these principles. The situation becomes especially acute when the question is raised as to whether the *concept* of cause corresponds to objective reality. Father Koren claims that it does, for otherwise there could be no sufficient reason for the real distinction of essence and existence in finite beings. But this appeal to sufficient reason is merely an argument within the framework of the analysis-of-concepts method and hence does not adequately overcome the Humean objections against the ontological validity of causality. This difficulty concerning efficient causality and other similar problems in this book force us to re-examine the metaphysical value of the method of conceptual analysis. If it is true that metaphysics studies the concept of being, then the analysis of concepts is the proper method of metaphysics. But, if metaphysics studies the concept of being, then in what sense is it a science of the real? It is precisely here that the main problem lies. Is the object of metaphysics the concept of being or actually existing, extra-mental being? The option that one takes at this initial point determines both the proper method of metaphysics and also the very meaning of metaphysical principles and their consequences.

Father Klubertanz's *Introduction to the Philosophy of Being* is based on the conviction that the material beings of our immediate experience are ontologically intelligible to the human mind. This does not mean that we know such beings exhaustively. Rather it means that finite material beings are neither entirely contingent nor entirely material and hence can be the object of necessary, intellectual judgments. This fundamental Aristotelian-Thomistic position determines both the point of departure and the methodology of the philosophy of being.

Metaphysics begins with the data of our immediate experience of material being as expressed in perceptual judgments. Such judgments implicitly contain the common intelligibility of being, or that which is. Metaphysics is formally constituted by a further negative judgment which separates the intelligibility of what it means to be from the intelligibility of material quiddity. Father Klubertanz's emphasis here on the role of judgmental knowledge enables him to avoid the pitfalls of metaphysical subjectivism.

The method of metaphysics is neither an analysis of concepts nor a deductive application of the principles of noncontradiction and sufficient reason. Rather, metaphysics develops primarily through the process of intellective induction by which the mind uncovers a series of ontological intelligibilities in real existents. This method is especially noticeable and valuable in the discussion of efficient and final causality. Extrinsic causality enters metaphysics as a result of our direct experience of efficiency and finality in real being. Hume's objections rightly attack the position that

causality is applied to real being rather than derived from it.

Father Klubertanz's presentation of metaphysics includes several other valuable points. First is his careful distinction between predicamental being and real being. The predicaments are being as known. Within each predicament we must distinguish *what* is known (ontological determination) and *how* it is known (universality, univocity, and so on). Confusion on this distinction has resulted historically in the attribution of a separate, *real esse* to accidents which are *understood predicamentally* as forms and substances. But, as the author maintains, although we attribute an *esse* to a substantialized accident in our understanding, the accident in being exists through the *esse* of the supposit. Hence real accidents do not have a separate *esse*.

Secondly, the doctrine of analogy is presented in its full vigor. The progressive development of metaphysics reveals several irreducible, overlapping analogies in being. For example, finite beings and their principles are analogous in several different ways, depending on the relational considerations involved. Father Klubertanz warns against an oversimplified reduction of analogy to one type. Metaphysical investigation reveals that the analogies of being are only analogously similar to each other.

From the teacher's point of view Father Klubertanz's textbook is helped by the inclusion of a large number of well-chosen English translations from St. Thomas. Practical considerations of size, however, necessarily limit the pedagogically desirable number of inductive examples. This latter point is left to the teacher.

This book is in many ways an invaluable guide in the search for metaphysical knowledge. It is a most welcome companion to the author's earlier *Philosophy of Human Nature*.

Father Edmund Ziegelmeyer has given us a quite readable translation of the second revised edition of Monsignor de Raeymaeker's *Philosophie de l'être. Essai de synthèse métaphysique*. This text is already well known in America as an approach to metaphysics through the analysis of human consciousness.

Reflection on the limitations of personal consciousness reveals that our ego is necessarily bound up with the world of the nonego. Moreover, this movement of reflection is simultaneously the epistemological guarantee of the certitude of our knowledge of both the ego and the nonego. Our sense life, which is completely organic, tends to obscure the processes of intellection.

Furthermore, consciousness of the ego contains an awareness of the self which is relative and an awareness of being which is absolute. This apprehension of the absolute value of being enables the human knower to

transcend the distinction of ego and nonego, both of which are relative, and thus establish the science of being. Hence metaphysics is specified as the science of being in its absolute value which transcends both the empirical data of the nonego and the subjective structure of the ego. The author defines the absolute value of being as follows: "Being is absolute, that is to say, considered as being, it is not relative to anything besides itself; for a relation with nonbeing could only signify an absence of relation" (p. 24). This definition is crucial. It appears to this reviewer to denote a logical property of our conception of being rather than the ontological intelligibility of existence which is the formal object of metaphysics.

For Monsignor de Raeymaeker the fundamental problem of metaphysics is the reconciliation of the one and the many, or, more accurately, the participation of relative modes of being in the absolute value of being. The solution of this general problem at the various levels of being and causality reveals the various intrinsic and extrinsic principles of being. By participation Monsignor de Raeymaeker means that particular beings possess certain perfections incommunicably; nevertheless, they are not themselves the adequate explanation of these perfections. The proof of the existence of God affords the ultimate reason of participated being.

Monsignor de Raeymaeker rightly asserts that "metaphysics cannot consist in a study of abstract essences" (p. 327). Metaphysics must deal with our experience of real being. Self-consciousness is undoubtedly part of this experience. But also included is a great deal of direct sensio-intellectual apprehension of extramental existents which cannot be underrated in metaphysics.

Professor Lazerowitz's *The Structure of Metaphysics* is a series of twelve independent essays dealing with various metaphysical problems. All but three have previously been published in various journals. Nevertheless, the volume reads with considerable unity because of the frequent recurrence of several interesting problems. For example, why is it that philosophers, unlike scientists, never seem to be able to agree on anything, even the most fundamental issues? Or again, why do some philosophers persistently hold theoretical views, like the denial of change or physical reality, which they themselves betray in their everyday actions?

Reflection on these perplexities has led Professor Lazerowitz to distinguish three levels of metaphysical thought. On the surface a metaphysical judgment gives the illusion that it deals with reality. Further analysis reveals, however, that the metaphysician has introduced, often unconsciously, a clever linguistic innovation in the meanings of commonly used terms. For example, in the metaphysical judgment "Change is impossible," the term

"change" has been skillfully altered from its commonly accepted meaning. If we ask why the metaphysician constructs such semantic illusions, the third and deepest level of metaphysical thought presents itself. Metaphysical judgments are attempts to bring our conscious life into adjustment with the deep-seated psychological fears and wishes of the unconscious. For example, the denial of change by some individual philosopher may be an attempt to quiet his fear of death in the unconscious. Hence the disagreement and apparent inconsistencies of philosophers have a psychological explanation.

This purely subjective nature of metaphysics ultimately derives from the author's view that metaphysics is concerned only with a-priori judgments. An experiential justification of a metaphysical view is out of the question. This extreme subjectivism should lead us to a fundamental re-examination of the value of the distinction between a-priori and empirical judgments as stemming from Leibniz and Kant. Does metaphysics deal with a-priori as distinct from empirical judgments? If this dichotomy is accepted, subjectivism must ultimately follow. If it is not accepted, other distinctions of knowledge are available to establish metaphysics as a science of the real. Furthermore, the recognition of the illusory nature of metaphysical judgments mentioned above implies that Professor Lazerowitz possesses a nonillusory knowledge of reality as a principle of evaluation. But unfortunately this latter type of knowledge does not come under investigation. Could such knowledge be developed into a realistic metaphysics?

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***Der Mensch als Mitte.*** By Josef Endres. Bonn: H. Bouvier u. Co. Verlag, 1956. Pp. 172. Paper, DM 9.50.

This work adds another volume to the series "Mensch und Welt," a collection dealing with problems especially pertinent to the present time and in which eight monographs have already appeared in the last three years, testifying to the activity of the Dominican editor, Father Fenyvessy. The present volume by the Redemptorist Father Endres, who is well known to the readers of *Divus Thomas* (Freiburg), is a clear and forceful presentation of the philosophy of man. The book develops this philosophy according to the principles of St. Thomas Aquinas, metaphysical, physical, and ethical, and discusses the entire theme throughout, with remarkable pene-

tration, against the background of the current philosophical and scientific views.

The title, *Man as a Mean*, expresses the basic motif of the book. The notion understood by *mean* is illustrated through two examples. One is that of truth, which is a mean not by way of compromise between opposite falsehoods but as a synthesis of all that is true in each of the contrary errors, a synthesis which is *specifically* different from either (p. 12). The other example is that of the virtuous mean, which is not a mediocrity but the high point of moral excellence, again specifically different from both contrary vices; and in the theological virtues it is a mean which makes a man rise above himself (p. 15). In these profound senses man is a mean between the merely corporeal and the entirely incorporeal, not as an externally united duality of opposites which retain their own specific characters, but as a true unity which is specifically different from either the purely corporeal or the purely incorporeal. For in man there is not a strict contrast between body and soul. The *spiritual* soul (*der Geist*) is the very form which along with the matter constitutes the body. From this basic substantial *unity* proceed *both* corporeal and spiritual functions (p. 111).

Father Endres is keenly aware that this substantial unity of man is not easy to understand. In fact, he characterizes it as the strangest and least to be expected of all types of union. But for that very reason it expresses in the most striking way the greatness of the Creator, just as the skill of an artist is best shown when he works out his conception in extraordinarily difficult material (pp. 111-12). The peculiar nature of this substantial unity requires that everything subspiritual in man should exist on account of the spiritual and so counters any fear that man because corporeal may be looked upon as a means and not as an end or be regarded as a material *thing* which has been infused with consciousness (pp. 112-13). It shows how man is a mean which remains open to what is above himself, so that man finds himself and becomes his nature in the fullest sense when he goes beyond himself and directs himself in his free conduct to the mean par excellence (*die eigentliche Mitte*), to whom he owes his being (p. 165). It results in conclusions which explain the twofold aspect of man as a person and at the same time as *part* of a community, as mortal and yet immortal, as endowed with both sensible and intellectual cognition, as free and yet as bound by moral law, as subject to anxiety and nevertheless secure (pp. 129-64).

The special merit of the work lies in the manner in which it handles the worthwhile features in current thought—for instance, notions about personality—which have been so strongly emphasized by recent philosophers such as Heidegger, Jaspers, M. Scheler, N. Hartmann, Sartre, to mention only

a few of those whose views are discussed. From these live sources it incorporates valuable insights into the philosophy of man by showing how what is true and appealing in their observations follows beautifully from the Thomistic conception of man's spiritual unity. The author's skill in handling such tenets emerges from the way in which he makes use of the emphasis and at times even of the terminology of the moderns without ever yielding to the temptation of allowing these features to retain the specific character which they had in their original sources. For instance, the status of man as a creature (*das Geschöpfsein*—[p. 116]) is not permitted to be bracketed for the discussion of modern philosophical themes. In this way the treatment is a living illustration of the basic example used of truth as a mean which gives a new specific nature to whatever it may absorb from any opposed views. The procedure likewise exemplifies how Thomistic principles, which in the thirteenth century could absorb and transform the meaning of so much that was true in Greek and Arabian sources, can still assimilate in vital fashion all that is best and most striking in modern thought and research, though now as then they have to give a specifically new character to everything that they encounter.

The book is written in a lucid and easy style that neatly exploits the force of German word-structure to press home philosophical meaning. It contains a bibliography and an index of names.

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